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ABSTRACT

A series of studies addressed basic questions about instruction in subject areas such as science and social studies at the elementary level, focusing on group discussion of textbook content and addressing the effects of instruction in terms of students' knowledge acquisition and their independent reading comprehension of new content. Subjects, fourth grade students (144 in all), either read independently (a control condition), or experienced instructional treatment conditions created to distinguish two primary methods of treating text content during class discussion: (1) "discrete" instruction, which isolated brief segments of text for oral reading and subsequent discussion, modeled on conventional practice in elementary classrooms; and (2) "integrative" instruction, which focused on larger content units and was designed to promote students' abilities to relate information within and across sections of text. Students read a series of 12 articles about three insect societies, in a specially prepared booklet over a 12-day period. A series of pretests and posttests was administered (to assess domain-specific factual knowledge, ability to use text as information sources, and approach to learning from texts), as well as daily tests (for understanding of factual information, ability to construct explanations, and application of knowledge in new contexts) and a measure of transfer to independent reading comprehension at the end of the study. Principal findings indicated that instruction significantly enhances both the amount and kind of knowledge students acquire. Further, integrative instruction is more effective than discrete instruction with respect to students' knowledge acquisition and independent reading comprehension of both related and unrelated material. (Six figures and 13 tables of data are included; 64 references are attached.) (Author/SR)

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CENTER FOR THE STUDY OF READING

Technical Report No. 480

DISCUSSION, COMPREHENSION, AND KNOWLEDGE ACQUISITION IN CONTENT AREA CLASSROOMS

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Abstract

A series of studies designed to address basic questions about instruction in subject areas such as science and social studies at the elementary level are described and findings reported. The focus of investigation was group discussion of textbook content, and the basic questions addressed concerned the effects of instruction in terms of students' knowledge acquisition and their independent reading comprehension of novel content.

Subjects for the studies were fourth grade students. Instructional treatment conditions were created to distinguish two primary methods of treating text content during class discussion: (a) instruction which isolated brief segments of text for oral reading and subsequent discussion, modeled on conventional practice in elementary classrooms and labeled discrete; and (b) instruction which focused on larger content units (a subsection rather than a paragraph), designed to promote students' abilities to relate information within and across sections of text, labeled Integrative. An independent reading condition, with no instruction, served as a control.

Students either read silently or participated in teacher-directed instruction, which included guided discussion of text content, after reading. The content was a series of 12 articles about three insect societies in a specially prepared booklet entitled Insect Societies, discussed and/or read over a 12-day instructional period. Prior to reading the articles students were administered a series of pretests designed to assess domain-specific factual knowledge, abilities to use texts as information sources, and approach to learning from texts. During the instructional period students completed a daily test of knowledge acquired after reading or instruction, without access to the text. These measures assessed understanding of factual information, ability to construct explanations, and application of knowledge in new contexts. At the conclusion of the study, all pretests were administered as posttests. Additionally, transfer to independent reading comprehension was assessed through measures constructed for each of three passages varying in degree of relatedness to the instructional material.

Principal findings indicate that instruction significantly enhances both the amount and kind of knowledge students' acquire. Further, Integrate instruction is more effective than Discrete instruction with respect to students' knowledge acquisition and independent reading comprehension of both related and unrelated material.

DISCUSSION, COMPREHENSION, AND KNOWLEDGE ACQUISITION IN CONTENT AREA CLASSROOMS

The purpose of the set of studies reported in this article is to increase our understanding of the complex set of theoretical and instructional issues involved in "reading to learn." Our interest in these issues stemmed from an intuition that both teachers and students were commonly frustrated in dealing with textbook content in subjects like social studies and science. This intuition led us to a series of descriptive studies dealing with the structure and content of student textbooks (Gallagher & Pearson, 1982) and the approaches teachers used in classrooms to handle texts that are typically too difficult for at least a third of their students to read on their own (Gallagher & Pearson, 1983).

In our classroom work, we learned that teachers at the intermediate level feel an obligation to make sure that students get a chance to "hear the content;" hence they engage in round robin oral reading of each chapter, stopping every paragraph or two to check comprehension. Most teachers wish that they could find alternative approaches to discussion or that they could rely on their students to read and learn the information on their own; but, in fairness especially to those with modest reading and studying skills, they revert to the tried and true method of oral reading and recitation.

These observations came at a time when we were beginning to be informed by research and theory from the study of human cognition and the study of the structure of prose. From our classroom observations we felt the need to develop and evaluate instructional alternatives to the conventional wisdom. From studies of the structure of knowledge and text came a framework for developing these alternatives. Once developed, we carried out a series of three intervention studies with fourth grade students to evaluate the effectiveness of these alternatives.

A primary assumption underlying our approach to instructional research was that the central goal is to understand the relationship between instructional and cognitive processes. Accordingly, we attempted to explicate the reading process as it is used to acquire knowledge from text. To identify cognitive processes that would likely be implicated in this type of reading, we turned to recent work in knowledge acquisition, text structure, comprehension, and metacognition as the most likely sources of insight. We tried to design a set of instructional procedures that would foster those processes we had identified.

As in any intervention study, one must decide whether to study the impact of key variables by manipulating them or by studying the effects of their natural variation through careful measurement. Our approach combines these two strategies. We always directly assessed the impact of our key variables; our decisions about what variables to manipulate were based upon what we learned at each stage of our research.

In the sections that follow, we will discuss the research relevant to both cognitive and instructional processes, report our findings from a series of three intervention studies, and discuss the implications of these findings for the more general issues involved in reading to learn.

The Classroom Context and Conventional Practice

Descriptions of Practice

If we compare the report of Joseph Mayer Rice's early impressions of American classrooms (1893) with more recent observational work (Durkin, 1978-79; Gallagher & Pearson, 1982), we find that, in some respects at least, practice has remained remarkably stable, indeed resistant to change. In visiting American classrooms Rice observed that a large proportion of time was devoted to the practice of "examining" students on their mastery of textbook information. Later, Burstall (1909) contrasted prevailing American practice to European practice, commenting that while European teachers tended

to lecture more frequently, inviting little participation from students, American teachers more often acted as meeting chairmen while textbook content was reviewed during discussion.

Not long after Burstall's observations, Romiett Stevens published her work based on observations of secondary school classrooms (1910, 1912). From Stevens' work, the democratic meeting chairman portrayed by Burstall reemerges as the adult who dominates instructional time with the initiation and control of a large proportion of the verbal exchange taking place in classrooms, most of which is rapidly paced questions usually requiring verbatim recall or only a superficial understanding (Stevens, 1912). Stevens' observations confirm Rice's earlier impressions and dispel Burstall's view of the teacher as a democratic facilitator. But, Burstall was correct in observing that American teachers did little lecturing; instead, American teachers engaged in a practice that has variously been termed oral examination, recitation, or discussion.

In a thoughtful review of the literature on recitation, Hoetker and Ahlbrand (1969) report that Stevens' work stimulated several additional efforts to observe and describe classroom practice. The motivation for this was two-fold: first, the characterization of practice emerging from Stevens' work prompted others to suspect that Stevens had selected extremely poor teachers to observe; second, the practices documented by Stevens were generally regarded as pedagogically unsound. But, later work largely confirmed Stevens' findings (Barr, 1929; Colvin, 1931). Teachers relied heavily on textbooks and spent large portions of class time querying the information contained in those textbooks. (For a more comprehensive treatment of earlier practice, see L. Cuban, 1984, *How teachers taught*.)

More recent descriptions of on-going instructional practice include those by Smith and Geoffrey (1968); Durkin (1978-79), Stodolsky, Ferguson, and Wimpleberg (1981; Stodolsky, 1988), Gallagher and Pearson (1982); Alvermann, Dillon, & O'Brien (1987). Smith and Geoffrey's work provides a painstaking ethnographic analysis of the events in one classroom. Working with inner-city children, the teacher adopted the practice, particularly in social studies, of devoting class time to what has been termed "hearing the textbook." That is, the teacher called on one student to read a portion of the assigned textbook material aloud. When the student finished, there ensued a brief exchange between the teacher and students of the information contained in or relevant to that section of the textbook. The lesson then proceeded by alternating oral reading and verbal exchange. This practice of "hearing the textbook" moves away from the earlier, more strict form of recitation when teachers called on students to recite from memory relevant material from the textbook. As it is still dominated by extensive teacher questioning, however (cf. Durkin, 1978-79; Goodlad, 1984; Sirotkin, 1983), many would be reluctant to grant it the status of true discussion. Nevertheless, as we shall see later, practicing teachers regard various forms of "hearing the textbook" as "discussions."

The work of Stodolsky (1981, 1988) is generally in keeping with the observations of Smith and Geoffrey, although Stodolsky and her colleagues distinguish between practice in social studies and mathematics classes. They observed several fundamental differences between the two types of classes, including grouping (whole class or small group), and specific student and teacher behaviors. For our purposes, some of the descriptive information the authors report about social studies instruction is particularly relevant. Nearly half (i.e., 44.4%) of the recitation time in social studies at the elementary (fifth grade) level was devoted to oral reading of the textbook and questions and answers. The textbook was the dominant material for both students and teachers (teachers relied equally as much on the textbook itself as on the manual accompanying it).

Consistent with the Stodolsky findings are Durkin's (1978-79) observations of elementary school classrooms. Durkin was primarily concerned with describing reading instruction, but her work did include a more limited set of observations of social studies and science instruction as well. In describing instructional practice in content area classrooms Durkin observed that there was very little of what she defined as text comprehension instruction, paralleling her findings about reading instruction. Rather, practice and assessment (asking questions about text content) emerged as far more common activities, with listening and responding to questions being the predominating student

behaviors. This Durkin attributed to the prevalent practice of allocating instructional time, particularly in social studies, to class discussion. Despite the prominence of the text in instruction (discussion, questions and answers concerning the textbook information), Durkin reports that she observed no instruction aimed at teaching children "how to be better readers of subject area texts" (Durkin, 1978-79, p. 520).

In a series of observations and follow-up teacher interviews conducted in 30 intermediate grade social studies and science classrooms, Gallagher and Pearson (1982) explored the role of the textbook in content area instruction. They concluded that, at least for their sample, content area instruction is textbook-dominated, and that this was particularly true in social studies. Though teachers cited the value of supplementary films, tapes, and pictures, as well as field trips, class projects, and guest speakers, most of the activities observed and the content covered was dictated by the textbook.

In addition to this very general observation, Gallagher and Pearson were also able to provide some descriptive evidence about the prevalent instructional activities, their sequence, and format. Typically teachers reported that they spent 2 to 3 weeks on each unit of content, repeating the same sequence of activities for subsequent units: The teacher introduced the unit; then students read the unit independently; afterwards the teacher and students discussed the unit material, covering one segment per day. During this same time period, students completed independent activities of two types: preparing written responses to teacher-prepared or textbook questions, and completing workbook exercises. At the end of the unit, students' mastery of the content was assessed by a test, prepared either by the teacher or the textbook publisher.

The format for unit introduction was most often a discussion, though a few teachers prepared advance organizers or study guides outlining the major topics in the textbook. Next, teachers covered the content, by following one or another of a very few formats. By far the most frequently observed format was to proceed through that day's segment of text by reading brief segments orally, stopping to discuss the information contained in that section, and then going on to read the next section aloud. Other formats, each observed rarely in practice, were teacher lecture, student formulation of questions to pursue, and discussion organized by teacher-prepared study guides.

Comparing more recent work with the impressions and observations recorded near the turn of the century, we find that in some important respects instructional practice has altered very little. The textbook continues to dominate. It is the textbook that delineates the knowledge to be acquired. The principal instructional activities continue to focus on the textbook as teachers direct students to first read portions of it aloud and then question students about the information contained in those portions. This then is the context providing the opportunities for students to acquire knowledge and develop skills to acquire knowledge on their own.

Evaluations of Practice

There have been relatively few efforts to evaluate the degree to which the instructional practices just described facilitate either knowledge acquisition or reading comprehension. Although such practice has been studied, the focus of inquiry has been to characterize the interaction between teachers and students as a social process (Bellack, Kliebard, Hyman, & Smith, 1968; Edwards, 1980, 1981), as having an underlying logic (Smith & Meux, 1970; Rosenshine, 1968), or as an avenue for cognitive development (Taba, 1966). In reviewing classroom interaction research, Dunkin and Biddle (1974) concluded that while much has been discovered about the processes of teaching through these studies, the implications for student achievement, even in the most general sense, are yet unclear. For example, although there is evidence that teachers could be trained to adopt many of the practices that Taba (1966) advocated, and indeed altered their practice, these changes in teacher behavior were not associated with corresponding changes in students' achievement.

Although there may be a variety of reasons for the failure to observe a consistent relationship between the teacher's practices and students' achievement, there are two which seem particularly relevant. One is that achievement has generally been measured in very global terms, perhaps masking some instructional effects. The other is that although the central role of the text has been frequently noted, the text has not influenced either the systems for characterizing group interaction or the indices of student achievement resulting from those interactions.

Given the dominance of textbooks observed by others, this is surprising; their contents would seem useful in creating various indices of student achievement, particularly knowledge acquisition. With the possible exception of Taba's work, which included extensive curriculum development, the descriptive and empirical work on recitation and discussion has eschewed text except to note its central role. The observational schemes developed by Bellack and Davitz (1963) and Smith and Meux (1970), and used with some modification by others, do not take into account the text material in use. A striking case in point is the fact that the most common practice for dealing with text, allowing students to "hear the textbook," has not been evaluated experimentally, even though its close dependence on the text would render evaluation relatively straightforward.

Despite the fact that there exists no index of its effects, "hearing the textbook" continues to provoke criticism from a variety of sources. Criticisms most often reflect the belief that the large numbers of questions directed at students by the teacher are not instructive in any meaningful sense (Stevens, 1912; Durkin, 1978-79). Others criticize the kind of questions, citing the high incidence of "low-level factual detail" elicited by teachers' questions (Guszak, 1967; Dillon, 1984) as a probable cause of lower overall achievement.

In summary, a survey of the classroom context quite clearly suggests that discussion of textbook content is the most prevalent *instructional* process to promote learning information. To explore the important *cognitive* processes, we turn now from the classroom context *per se* to the nature of the reading comprehension task as it operates within that classroom context. Since the goal of such instruction is to help students become more knowledgeable about specific domains of information, we are particularly interested in reading comprehension as a tool for acquiring knowledge.

Knowledge Acquisition and Reading Comprehension

Knowledge Acquisition

There is an increasing body of work in knowledge acquisition growing out of the more general work in schema theory. Briefly, schema theory (Rumelhart, 1980; Anderson & Pearson, 1984) posits the existence of abstract structures that represent the organization of knowledge in memory. New knowledge can be acquired through a gradual process of assimilation or through a process of restructuring in which either new schemata are created to augment existing schemata or old schemata are completely reorganized.

Depending on the congruency of the new and existing knowledge, existing knowledge structures may or may not be altered as new information is encountered. What has been less clearly articulated to date are the mechanisms that prompt or enable these changes in knowledge structures (Vosniadou & Brewer, 1985, 1988). Several mechanisms have been proposed, including induction of schemata, analogy and perceived anomaly or incongruity. To date, the evidence appears to support analogy as a powerful mechanism for restructuring (Gick & Holyoak, 1980, 1983; Vosniadou & Ortony, 1983); evidence supporting the other candidates is currently weaker.

In addition to the underlying processes and mechanisms of knowledge acquisition, there is a third area of concern that may be generally subsumed under the rubric, approach to learning. Included here would be the control processes of a metacognitive nature: how the learner approaches a task and monitors his or her subsequent performance while carrying out that task (Brown, 1980). Through the

selective exercise of these control processes (particularly for intentional knowledge acquisition), the learner is able to focus on the salient properties of the to-be-learned material in relation to what is already known and/or successful approaches to learning. For example, in order for analogy to operate as an enabling mechanism, the learner must first appreciate the principle of analogical comparison and then be able to identify and match parallel terms or categories on two or more instances. As the work of Gick and Holyoak (1983) indicates, the presence of a potentially useful analogy does not ensure that the learner will spontaneously notice and use it; for some learners the analogical properties of a second example with respect to the first must be explicitly signalled in some fashion. In a similar vein, Paris and Lindauer (1976) found that 7-year-olds would draw inferences about the instrument used to do a task (e.g., a key to open a door) only after they were encouraged to "act out" the behavior in the orally presented sentence. Even though they had the knowledge necessary to draw the inference, they did not spontaneously do so; in other words, they had the cognitive but not the metacognitive knowledge necessary for successful completion of the task.

The work of Bransford and his colleagues (Bransford, Arbitman-Smith, Stein, & Vye, 1985; Bransford, Stein, Shelton, & Owings, 1981) extends the notion of approach to learning. These authors have been able to distinguish more and less academically successful elementary school students on the basis of what they term level of sophistication. More sophisticated students appear to engage in a spontaneous search for significance when faced with the task of remembering specific factual information, rendering even arbitrary information more memorable. In contrast, their less successful peers apparently attempt to simply memorize the information verbatim.

The work on knowledge acquisition suggests that in designing instruction to facilitate knowledge acquisition several concerns be addressed. First, structure is important, both in the way existing knowledge is structured and in the way new information relates to it. Second, there are various mechanisms such as analogy or induction that enable the learner to relate new to known information and acquire knowledge. Finally, there are more and less productive approaches that learners may bring to the learning task. The extent to which instruction stimulates and fosters these fundamental processes, mechanisms, and productive approaches is likely to directly influence students' knowledge acquisition.

Comprehending Expository Text

Although to date there has been little research evaluating reading comprehension as a tool for knowledge acquisition, there are a number of separate strands of research that can be brought to bear on the issue. During the past decade, reading comprehension has been studied within the basic schema theoretic view described earlier. Several kinds of schemata have been associated with the comprehension process, most notably a schema for stories in narrative comprehension (Stein & Glenn, 1979), a schema for text structure (Meyer, 1975), and content specific schemata relating to the topic of a passage (Brooks & Dansereau, 1984).

We know from a number of studies that sensitivity to text structure is associated with higher levels of comprehension (Meyer, 1975, 1977; Meyer & Rice, 1982). Additionally, we know that students who initially exhibit low levels of sensitivity to text structure can be trained to attend to elements of structure (Meyer, Brandt, & Bluth, 1980; Taylor, 1982). Students can also be trained to recognize some common text structures in expository prose leading to enhancement of reading comprehension (Bartlett, 1978).

Related to this work on text structure is the work on study techniques based on structural elements (Brooks & Dansereau, 1984; Taylor & Beach, 1984). From this work we can infer that, in some cases, directing students to work with the overall content structure (headings and subheadings in the Taylor and Beach work; a structural or content schema in the Brooks and Dansereau work) proves to be facilitative for students. Further, in cases where the text organization closely reflects the organization of the content schema, comprehension is even further enhanced.

Closely allied to the Brooks and Dansereau (1984) work is the work of Armbruster and Anderson (1985) which develops the notion of a text content structure called a "frame." A frame is a content-dependent structure that corresponds to the cognitive entity, schema, and that reflects the underlying conceptual structure of the discipline. The frame is a particularly promising notion for content area instruction where large blocks of content are presented in a cumulative fashion. Recurring patterns or structures, specific to a particular content or knowledge domain, may help provide organization to a mass of information that may otherwise be unwieldy and difficult to integrate or synthesize.

Structure, then, is likely to be an important factor in applying reading comprehension skill to the knowledge acquisition task. Students' sensitivity to the structure of prose influences comprehension and so perhaps knowledge acquisition. While we have as yet no evidence about awareness or sensitivity to structure beyond the passage level (i.e., the domain level implicit in Armbruster and Anderson's notion of frames), we do have the Brooks and Dansereau (1984) findings suggesting that texts that preserve and reflect the underlying conceptual structure of the content domain facilitate comprehension.

The importance of structure is underscored by much of the work focusing on reader-based study skills that presume some knowledge of structure such as notetaking and outlining. Less conventional are techniques which emphasize structure, but portray it in visual rather than verbal form. These are the visual representation strategies such as networking (Holley & Dansereau, 1984), concept mapping (Armbruster & Anderson, 1980), flow-charting (Geva, 1984), Construct (Vaughan, 1984), and schematizing (Camstra & van Bruggen, 1984). The results of training students to use these techniques are moderately positive. Trained students demonstrate superior memory for and understanding of text material to which they apply these techniques when compared to the performance of untrained students.

In addition to the reader-based techniques, there are other, text-based practices that facilitate comprehension, and so perhaps knowledge acquisition. Of particular interest here, in light of some of the recent work on knowledge acquisition, is the practice of including supporting analogies in informational texts. Several researchers have found that the inclusion of some form of analogy facilitated comprehension (Hayes & Tierney, 1982; Mayer, 1979; Rigney & Lutz, 1976; Royer & Cable, 1976).

In summary, the work on comprehending expository text supports the position that using reading comprehension as a knowledge acquisition tool entails a general awareness of the influence of structure--both the influence of text structure that characterizes passage organization and the influence of conceptual structures that characterize the domain of knowledge under study. Knowing how to exploit structure to extract and differentiate superordinate and subordinate units of text (notetaking, outlining) influences comprehension. Similarly, generating a visual representation of content (networking, mapping, schematizing) serves to facilitate understanding. Comparable graphic representations included in the text, if not actually generated by the reader, also serve to enhance comprehension by providing an overall framework for the interpretation of information as do analogies by helping readers relate new to known information.

Developing an Alternative to Conventional Practice

Given the insights available from our review of the instructional context of content area instruction and our review of selected studies in knowledge acquisition and expository text comprehension, we are in a position to discuss alternatives to conventional discussion techniques. From these reviews it is clear that attention to *structure*, both the *text* structure and the underlying *conceptual* structure of the domain, must be a primary concern of content area instruction. In contrast to the conventional practice of introducing text topics in serial order as a series of discrete segments, an alternative practice which calls for the introduction of topics according to their relation to the superordinate structure of the

content was needed. Hence we developed an approach that sought to highlight important concepts and their interrelationships. To strengthen this basic plan, several additional features were included.

One was to provide clear visual representations of the text content on the chalkboard and/or on overhead transparencies. These representations could then function as visual reinforcements to help students understand key concepts and their interrelation, and as graphic analogies to help students understand the relationship between previously covered material and new material. Another feature was to encourage students to refer systematically to relevant portions of the text to support their contributions to class discussion and to model for them how to use subheadings to help locate requisite information.

More subtle features concerned helping students clarify their own learning goals. We provided them with orienting questions and later asked them to generate their own prereading questions, based on what they had already learned. We also used the summary and review portions of the lesson to help students relate information they had just covered to the accumulated body of content so that they could integrate information both within and across daily text segments.

In carrying out these plans, the teacher would then assume, at least initially, the primary burden of extracting structure, representing it, providing explicit analogies between old and new information, and guiding systematic reference to relevant portions of the text. In effect, the teacher would be responsible for guiding the group in an externalization of the internal studying process that skilled readers use. Continuing the comparison, we can observe that the conventional practice most closely resembles a studying technique of copious underlining, while the alternative resembles more closely the techniques that exploit the content structure. For clarity, the two resulting forms of instruction are labeled according to their respective manners of treating text content. That modeled on conventional instructional practice is labeled *Discrete* since text topics are treated serially and separately, while the alternative is labeled *Integrative* since text topics are treated in terms of their relationships to one another.

As the different instructional treatments were developed, the investigations were designed to allow the exploration of possible differences in the general effects of these two basic approaches relative to a set of questions:

1. Does instruction in the form of guided discussion of text content enhance students' knowledge acquisition? If so,

2. Does the type of instruction differentially influence students' knowledge acquisition?

3. Does instruction facilitate students' independent reading comprehension? If so,

4. Does the type of instruction differentially facilitate students' independent reading comprehension?

What follows is a report of a series of three studies, each designed to shed light on these questions. For each study, methods, results, and discussion sections are provided. Finally there is an overall discussion of the broad issues arising from our review and the questions that guided the development of the experimental design.

STUDY ONE

Study 1 was undertaken as a preliminary study to explore some of the methodological problems in conducting research involving the operationalization of both the Discrete and Integrative forms of instruction and of developing dependent measures sensitive to knowledge acquisition and independent reading comprehension.

In Study 1, Discrete instruction (modeled on conventional practice) was contrasted to independent reading (no instruction) and two variants of Integrative instruction (the alternative to conventional practice): one which added visual representations of text content to an integrative content discussion plan, and one which directed students to refer systematically to the text during discussion.

Method

Subjects

Subjects for Study 1 were 48 fourth-grade students drawn from two fourth-grade classrooms of an elementary school which served as the Laboratory School for a midwestern university. Subjects were randomly assigned to one of four treatment groups. Each group was composed of six students from one class and six from the other.

Treatment Groups

There were four treatments. One was an independent reading group receiving no instruction. The second was the Discrete instruction group; a third was Integrative with Visual Representation, and a fourth Integrative with both Visual Representation and Text Reference. All three of the instructional treatments included a form of guided discussion. That modeled on conventional practice, Discrete, involved oral reading and discussion of one paragraph at a time. The remaining two involved discussion of larger text segments, usually of entire subsections. Since the instructional treatments of the second, and more extensive study resemble those of Study 1 in many important respects, more detailed description of the instructional treatments is reserved for Study 2.

In Study 1 there were essentially two control groups, the Independent Reading group and the Discrete Instruction group. Two forms of an alternative to conventional practice, the Integrative form of instruction, were developed. Each of these shared the same manner of ordering and discussing the text content. What differed was the number of additional features included in the instruction. One of the alternatives included only the Visual Representation feature (graphically representing text content in chart form on the chalkboard); the other included Text Reference (directing students to cite specific portions of the text as they made contributions to the group discussion) *in addition to* Visual Representation.

Materials

Materials for the study included a series of five articles about ant societies used as instructional texts, lesson plans for each of the three forms of instruction, a series of dependent measures designed to assess knowledge acquisition, transfer to independent reading, and students' abilities to use texts as sources of information.

The instructional texts ranged in length from 400 to 600 words, and in difficulty from fifth- to seventh-grade level. In an effort to preserve the textbook-like quality of the materials, illustrations of many of the major concepts were obtained from published sources and included with the text. Similarly, the texts conformed to conventional textbook format through the use of titles and subheadings.

The dependent measures to assess knowledge acquisition included a 30-item multiple choice test about ant societies used as a pre- and posttest measure, and a short answer test of passage-specific factual knowledge accompanying each of the five instructional articles that students completed without access to the text, after reading or instruction. Measures to assess transfer to independent reading were a short answer test accompanying a new passage about another insect society, termites. The short answer test was parallel to the daily tests students had been completing during the instructional period. Additionally, there was an essay task accompanying the "termites" passage; this task required students to compare ant and termite societies.

Measures designed to assess text reference abilities included a speed and accuracy test of information location, and a test of the use of subheadings as indicators of text content. The information location test required that students locate answers to questions by underlining and numbering them in the appropriate paragraphs. In all there were four paragraphs with four questions each. The subheadings test required that students indicate the section of a passage that they would refer to in order to answer a series of 20 questions about that passage. Students were not required to actually answer the questions.

Procedures

Students in each of the three instructional groups met with the experimental teacher (who was the investigator) at regularly scheduled times for each of 5 successive days. Each day students in all groups first read one of the articles silently, then participated in one of the three forms of discussion, and then completed the short answer test without access to the text. Students in the independent reading groups remained in their classrooms and were supervised by their classroom teachers. They first read the appropriate article silently. When they finished, they went to the teacher and exchanged the article for the appropriate short answer test which they completed independently (without access to the text) and turned in to the teacher.

Analysis. For the analysis, a set of treatment contrasts was created. These involved comparisons between treatment groups corresponding to the basic questions posed at the outset. The contrasts were:

(1) Instruction/No Instruction (three instructed groups compared to Independent reading)

(2) Discrete/Integrative (Discrete compared to the two forms of Integrative)

(3) Text Reference/No Text Reference (Discrete and Integrative with Text Reference compared to Integrative with Visual Representation).

Working within a hierarchical regression framework, the entire set of dependent measures was first evaluated for covariate by treatment interactions. Because there were no such interactions, subsequent analyses proceeded using the reduced model evaluating first the effects of the covariate (prior knowledge) and next the treatment contrast effects.

Findings. For both Knowledge Acquisition and Transfer to Independent Reading, there was a powerful effect for prior knowledge, accounting for from 28% to 54% of the explained variance. As Table 4 indicates, there was also a significant effect for Contrast 1 (Instruction) on the multiple choice posttest and on each of the daily short answer measures (all means and standard deviations are shown in Tables 1-3). Consistently, students participating in some form of guided discussion acquired more knowledge than students who read the material on their own. Instructed students maintained their advantage on the short answer test of their independent reading comprehension of related content.

[Insert Tables 1, 2, 3, & 4 about here.]

There were a few significant effects for the other treatment contrasts, but there was no apparent pattern to these effects for either Knowledge Acquisition or Transfer to Independent Reading.

Discussion. The results of Study 1 indicate that there is a strong and consistent effect for instruction on students' knowledge acquisition and on their independent reading comprehension. There is no evidence, however, to indicate that the type of instruction differentially influences either knowledge acquisition or independent reading comprehension.

Recognizing that with only 12 students per treatment group and an instructional cycle of only 5 days, there might not have been sufficient time for instructional effects to emerge, a second, more extensive study was designed and carried out.

STUDY TWO

The purpose of Study 2 was to investigate more carefully the central questions addressed in Study 1. Specifically, the intent was to plan and execute instruction in such a way that transfer effects to independent reading could be assessed more reliably. Accordingly, Study 2 had a longer instructional cycle and a correspondingly richer domain of instructional material: The knowledge that children could acquire was potentially more extensive.

By exposing children to more information over a longer period of time, it might then be reasonable to expect more structure in the domain and correspondingly greater opportunity for children to acquire a schema for that domain. Over a longer period of time children might internalize both knowledge about the domain under study and knowledge about how to use texts as information sources. Both of these knowledge sources could increase the students' independent reading comprehension performance.

The most powerful alternative to conventional practice from Study 1, the *Integrative* with both Visual Representation and Text Reference, was selected for comparison to independent reading and conventional practice (*Discrete* Instruction). Even though the two forms of instruction differ in more than one respect, the first priority was to evaluate their overall effects, leaving the exploration of the more specific reasons for any observed differences for later investigation.

In this second study, although still a fairly tightly controlled study, a serious attempt was made to simulate more features of actual classroom instruction. This meant preparing materials that "looked like" school materials to the children; that is, they had to reflect important features of commercially prepared curricula. It also meant that classes should be held in an actual classroom with conventional furniture and equipment (chalkboards, overhead projectors, etc.).

From the beginning this study was conceptualized as an intermediate step (in between a laboratory experiment and actual field testing) in the process of developing and evaluating instructional procedures for eventual use by classroom teachers. The belief was that it would have greater generalizability than a true laboratory study but less than one carried out with several different teachers implementing each type of treatment. If findings from this study provided clear evidence about differences in treatments in terms of students' outcomes, there would then be a firm basis for suggesting that teachers explore similar alternatives in their own practice. This is a particularly important consideration when an alteration may displace practices that are at least moderately effective.

Many of the methods, materials, and procedures from Study 1 were used in Study 2. There were, however, some important differences in addition to those already mentioned. First, two additional categories of dependent measures, Approach to Learning and Knowledge Frameworks, were included. The Approach to Learning measures represented an attempt to assess some of the metacognitive processes presumed to operate during knowledge acquisition and/or reading comprehension. Measures in the Knowledge Frameworks category were designed to assess some of the more abstract knowledge, such as a schema for insect societies or a schema for text organization, that students might acquire.

Another difference was in the development of various elements of the general lesson format of Study 1. In Study 2 the review and preparation for silent reading segments received more attention. Also, in an attempt to heighten the engagement of students in the Integrative treatment, and to expose them to the uses of charts that visually represented content, simplified versions of class charts were prepared for individual use as study guides during silent reading and discussion. Prior to implementing the

experimental procedures for Study 2, the investigator worked in three different elementary schools with widely varying populations in an attempt to refine the instructional procedures.

Method

Subjects

Subjects for Study 2 were 72 fourth-grade students drawn from two intermediate level schools (grades 4 through 6) in a medium-sized suburban school district. Administrators of this school district describe it as a middle-class community distinguished primarily by its balanced racial mix. All students came from self-contained classrooms.

Assignment of subjects. The assignment of students to one of three treatment groups proceeded in two phases. First, the district administration had requested that all treatment groups represent a mixed balance of students, comparable to their classrooms, so that no group would differ substantially from the others in terms of racial composition.

To ensure that the treatment population resembled as nearly as possible a typical fourth-grade mix, Fall reading achievement scores for the entire fourth grade of the district were obtained. Students who were either extremely low or extremely high achievers were eliminated from the pool. This restricted the group of eligible students to those students with scores falling between 3.0 and 7.5 on a grade equivalent scale (Gates-MacGinitie Reading Achievement Test, Level D (1972)). This pool, after the initial screening, became the population (in each building) from which students were randomly selected and assigned to treatment groups. In one building there were three participating classrooms, and in the other, two classrooms. In an attempt to minimize effects due to classroom teacher differences, each treatment group was constructed from equal numbers of students from each of the participating classrooms. In one building this meant that there were four students from each classroom in each treatment group; in the other building, there were six children in each treatment group; the final result was a total of six groups of 12 students each. The appropriate number of students was randomly selected from each room, and then randomly assigned to a treatment group. After the groups had been constructed, their racial composition was examined by the district administration for approval. It was not necessary to make any changes in subject assignment to meet the racial balance requirements.

The Experimental Teacher

There was one teacher for all the treatment groups in the study. Again, the attempt was to eliminate as much variation as possible stemming from teacher differences. The teacher was the senior author of this paper.

Instructional Treatment Groups

There were three instructional treatment groups: Independent Reading (no instruction), Discrete Instruction, and Integrative Instruction.

Independent reading group. Students in this group read all the material silently. They did not participate in any form of discussion or instruction. Nor did they talk about the material in an informal fashion with each other or with the teacher. In one sense this group served as a control for the other two groups--the absence of any form of instruction. In another, though, it served as an important information source about what children can do with unfamiliar information when left to their own devices. From such a group we can begin to get a sense of the scope of the instructional problem both teachers and students face. By including this group in the experiment, it was possible to evaluate whether either form of teacher assistance improved understanding.

Discrete instruction group. In this treatment group, designed to simulate conventional classroom practice (cf. "hearing the textbook"), after silent reading, students took turns reading the text aloud, paragraph by paragraph. As a student came to the end of a paragraph, the teacher initiated a discussion of information *in that paragraph* without referring to information already discussed in previous paragraphs or foreshadowing information from later paragraphs. Since the focus of each discussion segment was a single paragraph, the questions that guided the discussion centered on specific factual information rather than relations between facts that might appear in separate paragraphs. This restriction of focus did not prevent the teacher from asking inferential or explanatory questions; it simply minimized the opportunity for posing such questions when they might require cross-paragraph integration of content.

In the course of a class period, students read and discussed one section of the instructional booklet entitled *Insect Societies* prepared for the study. The general orientation suggested to students by the teacher was one of "getting the facts straight."

Integrative instruction group. In this treatment group students participated in a discussion that was designed to provide them a more comprehensive view of the domain under study. Accordingly, relations within and across text segments formed the basis for planning the discussion. Two additional features characterized this form of instruction: (a) the text information was graphically represented for and by the students in the form of a chart drawn on the chalkboard or on overhead transparencies during the course of the class (Visual Representation); and (b) students were encouraged to refer to the text repeatedly during class as the teacher asked them to find and read pertinent sections of the text to support or clarify answers to questions raised during discussion (Text Reference). In the course of the instruction, the teacher modeled for students strategies for surveying the text in order to find pertinent information, making frequent reference to section titles and subheadings within sections. In contrast to the general orientation to the material suggested by the teacher for the Discrete instruction group, the orientation suggested for the Integrative group was one of "seeing how the facts fit together."

Instructional Materials

Texts. Student texts were specially constructed for Study 2. A booklet entitled *Insect Societies* consisting of 14 distinct sections was prepared. The domain of knowledge for students to acquire, then, was insect societies. This topic was chosen for several reasons. First, it is a topic that is generally outside the fourth-grade science curriculum, rendering the material unfamiliar to the maximum number of students. Second, though the topic is not usually covered in fourth-grade science, it certainly falls within the scope of content that fourth-grade students can understand. Finally, the topic is one that students of this age find interesting.

In the construction of the materials, many of the same criteria adopted for Study 1 were used. First, the format was to resemble as closely as possible that of a typical content area textbook. This meant that there would be a table of contents, section titles and subheadings. Also, there were pictures with captions, illustrating some of the more salient topics mentioned in the texts.

The booklet contained two introductory sections about social organization in the animal world and then three separate chapters, one for each of three insect societies--ant societies, bee societies and termite societies. In preparing the content for the different chapters, the first decision concerned the structure of information to include about any insect society. A general structure or framework was determined, and then information about each different society was gathered and structured along parallel lines. The general framework for each society was,

Insect Society

A. Getting Started

1. Mating

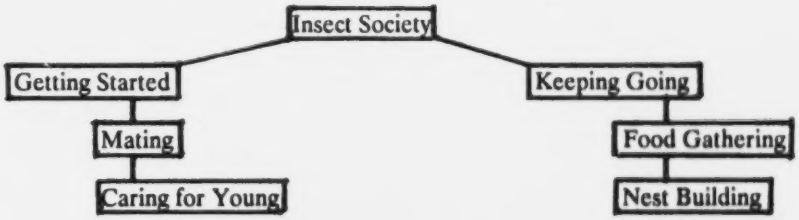
2. Caring for Young

B. Keeping Going

1. Food Gathering

2. Nest Building

This information was then displayed in chart form:



Each of the chapters about the different insect societies addressed these topics explicitly, repeating the appropriate section titles and subheadings whenever possible. So, for example, the section beginning the chapter on ant societies contained a subsection with the heading *How an Ant Society Begins*; the section beginning the chapter on termite societies contained a similar subheading, *Starting a Termite Society*. In designing these materials, particular efforts were made to ensure that the subheadings did, in fact, signal the content contained in the subsection so that the booklet would represent a good example of the factors we know or suspect lead to well-written, or considerate, student textbooks (Armbruster & Anderson, 1984).

Sections varied in length from 400 to 600 words. Difficulty, as measured by two readability formulas, also varied. Readability levels for each daily section were calculated using the Dale-Chall and the Fry scales. As is evident from Table 5, there is a range of difficulty levels represented, according to these formulas. Determining actual difficulty of content materials is problematic, however, and these formulas were originally developed for use primarily with narrative texts, rather than expository. Since one of the principal factors is word length and/or unfamiliarity, content materials rich with specialized vocabulary are apt to be rated as quite difficult. Substituting other, perhaps more familiar words for the longer, less familiar items is likely to compromise the precision of these texts, and hence the accuracy of the information being related. The decision was made to allow the difficulty to vary, reasoning that as information was being presented in a cumulative fashion, with many items repeated, and many concepts recurring, the true difficulty would be nearly impossible to gauge.

[Insert Table 5 about here]

In order to simulate real texts, pictures were included to illustrate as many of the main concepts as possible. These were taken from a variety of published sources, and labeled using the language of the texts. In selecting pictures, criteria of clarity and realism were used.

Lesson plans. For each of the two discussion treatment groups (Discrete and Integrative treatments), lesson plans were drawn up using a pre-determined format. To ensure that the same basic information was introduced during discussions for each treatment group, a content outline for each section of the

booklet (students read and/or discussed one section each day) was prepared. These content outlines then were used to develop matrices which visually displayed the content. As plans were drawn up for each instructional group, they were checked against these Lesson Matrices to ensure content coverage.

For the Discrete Instruction group, plans were formulated in the following fashion. For each paragraph of the text section, questions about the information in that paragraph were written to guide the subsequent discussion.

The lesson plans for the Integrative form of discussion were more complicated. First, using the appropriate Lesson Matrix, the basic structure of the section was outlined, revealing the major topics and their relations to one another. Next, the text was divided into units for discussion; usually a discussion unit corresponded to a subsection within one day's section of the booklet. Finally, topics within discussion units were identified, and discussion questions written for the topics. These questions were checked against the appropriate Lesson Matrix, as were the questions for the Discrete group.

When the daily section had been outlined, there remained several other steps for the Integrative lesson plans. First, a chart representing the overall structure of the section with the content appropriately displayed was prepared. This chart would be duplicated on the chalkboard and filled in by the students during class discussion. Since so many sections of the text lent themselves to a two-way classification organization, the chart usually took the form of a matrix with column and row headings. Next, the text section was related to the entire chapter, and where appropriate, to the entire booklet. So, for example, the third section of Chapter One, Ant Societies--"Next Construction in Ant Societies: Above Ground Nest Building," an overhead transparency was prepared showing where, in the general framework, this section fit:

Ant Societies

Getting Started

Mating

Caring for the Young

Keeping Going

Food Gathering

Nest Building

Above Ground

Below Ground

During class sessions for this treatment group, the teacher's objective was to have students understand the relationships evident within each text section and across text sections as the instructional cycle progressed. In contrast to the Discrete form of discussion in which the emphasis was on "getting the facts straight," the integrative form of discussion emphasized "getting the big picture." The "big picture" expanded as the unit progressed, emphasizing the cumulative nature of the information and the structural characteristics of the material. So, for example, when the topic of Starting Bee Societies was covered, the students were encouraged to compare the information to the parallel topic for ant societies which they had read about a week earlier.

Transparencies. Overhead transparencies were prepared for the Integrative Treatment group. These were of two types. One type was simply a copy of the chart that the teacher and students completed together during a class session. This then was used in two different ways: (a) as the material for a brief review at the beginning of the next class session, and (b) as a means of helping students determine the sorts of information they would likely encounter in another text section on the same topic. For example, when the students were about to read the section on Nest Building in Bee Societies, they looked at the chart(s) prepared for Nest Building in Ant Societies. This served as a means of focusing the students' attention on the topics they would encounter, as well as the sort of information they could

find out about those topics (i.e., which questions they should be asking themselves). As such, these transparencies functioned as graphic analogies.

Study guides. For the students participating in the Integrative form of discussion, Study Guides were prepared. These Study Guides duplicated the format of the charts that were displayed on the board or on overhead transparencies on a daily basis. Beginning with the second chapter of the booklet, Bee Societies, students filled in their study guides as the class progressed through each day's material. For the early study guides, all of the row and column headings were provided for students; for the later guides, these spaces were left blank for students to fill in themselves.

Procedures

The classroom. Both classrooms, one in each school, were standard classrooms, equipped with tables, chairs and chalkboards.

Overall procedures. The entire set of procedures was first carried out in one building, and then repeated 4 weeks later in the second building.

To reduce potential bias stemming from testing treatment groups separately, students were pretested by classroom, rather than by treatment group, over a period of 3 days. At the conclusion of the pretesting period, all participating students attended, again by classroom group, two 50-minute orientation sessions. During these orientation sessions students were told the purposes of the study, introduced to the camera operators, and were allowed to watch themselves on videotape. Additionally, the orientation period served to introduce students to the domain that they would be studying, insect societies. Two discussions were held, one on each of the orientation days, about social organization in the animal world.

After the orientation period, students reported to the classroom by treatment group at regularly scheduled times each morning. In the first building the Discrete Instruction group met first, the Independent group next, and the Integrative group last. In the second building, the order of meeting for the two instructional groups was reversed. In all other respects, the procedures followed in the two buildings were precisely the same. All lessons in both buildings were videotaped.

At the conclusion of the instructional cycle, students were posttested over a 5-day period. Again, students reported for testing by classroom rather than by treatment group to minimize bias in testing.

Class meetings. Daily class sessions lasted 45-50 minutes for the two instruction groups and 20-25 minutes for the Independent group. Students from all the groups returned to their classrooms as soon as they had completed their daily worksheets. For each of the 12 days of instruction, the lesson plans preserved parallel format for the respective groups.

Daily Lesson Structure and Time Allocations:

Independent Reading Group

I. Silent Reading 10 minutes

II. Daily Worksheet 10-15 minutes

Discrete Instruction Group

I. Brief Review 3 minutes

II. Silent Reading 3-5 minutes

III. Oral Reading and Discussion 25-35 minutes

IV. Brief Summary 3 minutes

V. Daily Worksheet 10 minutes

Integrative Instruction Group

I. Brief Review (with transparencies) 3 minutes

II. Pre-reading Orientation and Purpose Setting 2 minutes

III. Silent Reading 3-5 minutes

IV. Discussion and Board Work 25-35 minutes

V. Brief Summary (with transparencies) 3 minutes

VI. Daily Worksheet 10 minutes

The approach to the design of instruction adopted for this study was to exploit each component of the lesson structure in a manner consistent with the overall goal of the type of lesson. So, for example, during the purpose-setting portion of each Integrative lesson, the teacher intentionally attempted to promote children's tendency to relate known to new information by using previously covered material to help define a purpose for reading and discussing new material. Since relating new to known information was not a basic goal of the Discrete instruction, the teacher defined purpose in a very general way for students, restricting their attention to one specific section of the booklet, the topic of that day's section.

Although each instructional group of students engaged in reviewing and summarizing, the *forms* of review and summary differed for the two groups. In essence, these differences of form represented realizations of the fundamentally different goals of the two kinds of instruction. To illustrate briefly, for the Integrative instruction, the scope of the content was presumed to widen as students were exposed to more material. Therefore, the teacher reviewed the previous day's material *in the context* of all previously covered material. Similarly, when summarizing, the teacher encouraged students to consider that day's information in light of previously discussed content (e.g., What sorts of food do you suppose the underground nest builders gather?). During the review and summary portions of the lessons for the Discrete group, on the other hand, the teacher focused instead on that day's material, maintaining a consistently more narrow focus throughout the different parts of the lesson.

As a rule the class meetings for the Discrete Discussion group tended to be shorter (by 2-4 minutes) than those for the Integrative Discussion group. This difference reflected mainly the time for review and the prereading orientation reading in the Integrative Instruction group.

For the Independent Reading group the teacher gave each student a copy of the *Insect Societies* booklet when all the students were assembled. As students finished reading the appropriate section of the booklet, they came to the teacher to exchange the booklet for the appropriate Daily Worksheet. Students then completed the worksheet without access to the booklet. When they had finished with the worksheet, students turned it in to the teacher and returned to their classrooms. During silent reading, students were told that they could ask for help with words that were difficult to pronounce. It was explained that no help could be given with the worksheets. Students were allowed as much time as they wished to complete their silent reading. Because of the lack of interaction in this group, their interest and morale was carefully monitored throughout the study by the experimental teacher, the classroom

teachers, and the principals. Throughout the study these students faithfully came to class and completed their worksheets; no overt complaining was observed.

Students from the two discussion groups received the same worksheets after the summarizing portion of the lesson. They completed these worksheets independently, without access to the text.

No formal feedback about their performance on the Daily Worksheets was given to any group of students. To guard against potential bias, the teacher did not score the worksheets until after the study was completed; therefore, during the actual instruction, the only information regarding student performance available to the teacher was their class performance during discussion.

To determine whether or not students were completing the worksheets correctly, the teacher did read all of the first set of worksheets. Many students were supplying answers that were too abbreviated to answer the questions adequately. At the beginning of the second class meeting, the teacher showed students sample answers to one of the previous day's questions. One answer was extremely brief and the other more detailed. The teacher asked the students to judge which answer was the better, showing more about what the student knew. A quick perusal of the second day's worksheets indicated that students were, in general, supplying more complete answers to the questions. No further discussion of this sort took place for the remainder of the instructional period. The same example was used in the second building on Day 2 of their instruction.

Design and Analysis

Overview of Design

The design of this study is a 3 x 2 Factorial, with three levels of Instruction and two levels of School. This design allowed us to address two primary questions concerning the consequences of instruction:

1. Does instruction, in the form of guided discussion, enhance students' knowledge acquisition and/or their independent reading comprehension?

2. Does the *type* of instruction differentially influence student performance with respect to either knowledge acquisition and/or independent reading comprehension?

In simpler terms, following such instruction, do students know more about what they have read? And, are there any differences in their independent reading of content area texts they have never seen before?

To address these questions, a series of hierarchical regression analyses were carried out for each of several categories of dependent measures. Using two covariates (reading ability and content vocabulary knowledge or the appropriate pretest score for measures not directly related to specific knowledge), the same general framework was employed for all of the regression analyses. These analyses were carried out in two phases: (a) evaluation of covariate by treatment interactions and (b) evaluation of treatment effects.

The treatment effects were evaluated through a set of orthogonal contrasts corresponding to the two primary questions. Accordingly, Contrast 1 compared the two types of instruction with independent reading. Contrast 2 compared Discrete Instruction with Integrative Instruction. Below, the general hierarchical framework for the full model equation is described in the order in which effects were removed from the model.

STEP

(1) Covariates:

  (a) Reading Ability (RA)

  (b) Content Vocabulary (V) (Or appropriate pretest)

(2) School (S)

(3) Treatment Contrasts

  (a) Contrast 1 (C1)

  (b) Contrast 2 (C2)

(4) School X Treatment Contrast Interactions

  (a) School X Contrast 1 (S X C1)

  (b) School X Contrast 2 (S X C2)

(5) Reading Ability by Treatment Interactions

  (a) RA X S

  (b) RA X C1

  (c) RA X C2

  (d) RA X S X C1

  (e) RA X S X C2

(6) Vocabulary by Treatment Interactions

  (a) V X S

  (b) V X C1

  (c) V X C2

  (d) V X S X C1

  (e) V X S X C2

Evaluation of covariate by treatment interactions proceeded in two steps, using the general formula (Kerlinger & Pedhazur, 1973):

$$F \text{ ratio} = \frac{(R^2F - R^2R)/(J-K_i)}{(1 - R^2_F)/(N-J-1)}$$

(Where F = Full and R = Reduced, J = total predictors, and K_i = predictors of Step i).

To begin the evaluation, the full model included all the terms up through Step 6. Using the formula given above, interaction of the Vocabulary covariate and treatment effects was tested (five terms of Step 6). If this step (combined across all five interaction terms) was not significant, the same set of procedures was used to evaluate Step 5 of the Full Model equation, the set of Reading Ability by treatment interaction terms.

At the outset, the plan was to evaluate the entire set of dependent measures for possible covariate by treatment interactions in the same fashion. If there *were* covariate by treatment interactions, the interactions would be separately analyzed using the Johnson-Neyman technique (Kerlinger & Pedhazur, 1973). If there were *no* covariate by treatment interactions, the twice-reduced model (eliminating Steps 5 and 6) would be used to analyze performance on the dependent measures.

Working with the reduced model, the data would first be analyzed for interactions of the main effects (School X Treatment Contrasts). Simple effects test (treatment contrast within building) would be carried out for all such interactions. If there were no such interactions, the main effects would be interpreted.

Originally, there was a third covariate for these analyses, Pretest on Specific Factual Knowledge about Insect Societies. Due to very low reliability (alpha = .03) caused by the children's limited prior knowledge about insect societies, this measure accounted for very little variance and was dropped from the analysis.

As the analyses were completed, they were examined by category of dependent measure to increase clarity in the interpretation of findings. Each category and the measures developed for it is described more fully in the following sections. In all, there were five categories of dependent measures: (a) Knowledge Acquired, (b) Transfer to Independent Reading, (c) Text Reference, (d) Approach to Learning, and (e) Knowledge Frameworks.

Covariate Measures

Test of reading achievement. Student scores for the Gates-Macginitie Reading Achievement Test, Level D (1972) (October norming) were released for use in this study. These scores were used initially to screen students for the sample of eligible students, and later as a covariate in the main regression analyses.

Content vocabulary test. This was an Anderson-Freebody Vocabulary test (Anderson & Freebody, 1983). It consisted of 100 words. For each word, students were to indicate whether or not they knew what it meant by circling either yes or no beside each word. Included in the list of 100 items were the usual proportions of content words, pseudowords, and standardized vocabulary test words (taken from the Stanford Reading Achievement Test, Vocabulary Subtest (Form B, 1976)). This measure was designed to measure students' general (as distinct from specific) knowledge about the domain of insect societies, prior to reading and/or discussing the *Insect Societies* booklet. It was to serve as an additional covariate in the analyses of covariance and was administered as a pretest only.

Knowledge Acquisition Measures

These are among the principal measures of the study, since the first of the primary questions concerns students' acquisition of:

Multiple choice tests of factual knowledge. There was one multiple choice pretest of 30 items, with five answer choices for each, one of the choices an 'I don't know' option. The items were generated in the following manner. First, using the Lesson Matrices of text section content, two questions for each of the 12 instructional sections of the Insect Societies booklet were written. These questions corresponded to information that was prominent in the content outline and explicitly stated in the text. Additionally, six more general questions were written relating to the generalized insect society framework (e.g., food gathering, nest building) or social organization in the animal world. This pretest was designed to provide an indication of the specific factual knowledge about insect societies that students possessed prior to the instruction. By intention it was later to serve as a covariate in the analyses of covariance; however, as already mentioned, it was dropped for lack of reliability.

For the multiple choice posttest, the 30 items used in the pretest were combined with an additional 30 items about the text content. These items were generated in the same fashion, so that for the posttest there were four items about each of the 12 sections of the booklet. The multiple choice posttest was administered in two parts on separate days, with the first 30 items in Part I and the second 30 items in Part II.

The daily measures. There were 12 Daily measures, one for each of the four sections of the three chapters of the *Insect Societies* booklet. The worksheets, as they were described to the students, all followed the same format, requiring short written answers to 10 to 12 questions about each day's content. Comparable measures from Study 1 allowed the evaluation of the quantity of students' knowledge but not the quality or kind of knowledge. Accordingly, although the exact number of questions varied from worksheet to worksheet, each worksheet included three types of questions: factual, explanation, and application. The factual questions were about information explicitly stated in the text (e.g., What sort of food do the juice-drinker ants eat?). The explanation questions required that students describe or explain in their own words some aspect of the content (e.g., Explain how bees communicate information about food sources). The application questions required that students use some aspect of the information covered in a new context (e.g., Some termites never leave the mound; what makes this possible?).

Transfer to Independent Reading Measures

These measures were designed to address the second aspect of the primary questions under study: Does instruction influence students' independent reading comprehension? Three passages were prepared that varied in degree of similarity to the instructional material, using the categories of topic and structure to differentiate degrees of relatedness. The three topics were--in decreasing similarity--Paper Wasps (closely related), another insect society, Micmac Indians (related, a human society), and Landforms (completely unrelated).

During the posttesting period, students first read one of the passages. After finishing, they exchanged the passage for a short answer worksheet similar to the ones constructed for the Daily measures. Next, for the Paper Wasp and Micmac Indian passages, they completed a written task that required them to note similarities and differences between the information in each of the passages and the material read during the instructional phase. For the third passage (Landforms), which was unrelated, the written task was a free recall task.

The logic of these transfer tasks was as follows. If instruction transferred to Paper Wasps but not the other two, then one might argue that an insect society schema was responsible for transfer. If transfer extended to Micmac Indians but not Landforms, then generalization from insect societies to societies in

general might also be responsible. However, if transfer extended all the way to Landforms, then the inference is permitted that students, in addition to what they learned about insect societies and social organization, must have acquired a schema for how texts are organized.

Text Reference Measures

There are two measures in this category; each relates to a different aspect of the text reference feature of the Integrative Instruction treatment. Both measures were administered as a pre- and a posttest.

Locating specific information. This measure consisted of a series of four paragraphs adapted from a fourth-grade social studies textbook. After each paragraph, a list of four questions appeared. The students' task was to underline the section of the paragraph that provided the information necessary to answer each question and to put the number of the question beside the underlined part. This was a timed measure; the students all began at the same time, and each recorded the time of completion by referring to a digital display clock (minutes and seconds) placed in the front of the room.

Using subheadings as a guide to content. This measure was designed to assess students' ability to use subheadings to help them locate appropriate content. The task involved referring to a 7-section passage entitled "Rice Growing on Java." Each section had an underlined heading and a number placed in the right-hand margin. Students used an answer sheet divided into two parts. First, there was a list of 20 questions. The students were to read each question and decide whether or not the article would have the answer to the question. Students were explicitly told that they did *not* have to read the passage to complete the answer sheet. After indicating (by circling 'yes' or 'no' for each question) whether or not they thought the passage would contain the necessary information, students went on to the second part which entailed identifying the correct section for each of the questions with a 'yes' answer in the first part. This, too, was a timed test; students were allowed 4 minutes to complete this test.

Approach to Learning Measures

The three measures in this category were designed to assess various aspects of reading comprehension skill presumed to operate during content area reading. Each was administered as a pre- and a posttest. If, in the analysis of the transfer measures, there appeared to be an effect due to instruction, particularly on the third, unrelated passage, information about the various skills these measures were designed to assess might add explanatory precision.

Determining relevance of information (The Queth). For this measure a passage describing a hypothetical alien was prepared. The passage contained various information about the physical characteristics of this alien (called the Queth).

After students had finished reading the passage, they were given a sheet with a problem stated at the top. Below the problem was a list of questions. The problem asked students to imagine that they were scientists working in a laboratory. Further, they were to imagine the following scenario: Someone brings an unidentified creature to the laboratory. They think the creature is a Queth, but are not sure. They ask the scientist to examine the creature and decide whether or not it is a Queth or some other kind of alien.

After reading the scenario (read aloud to the students, after they had read silently), the students were to read all of the questions listed in the section below and put a check by *only* those questions that they would need to ask in order to decide whether or not the creature was, in fact, a Queth. The students could choose as many questions as they liked, from 1 to 17 (the total number of questions). The questions varied from critical to irrelevant, with important and relevant being intermediate categories.

Relating new information to old (Elzars). For this measure a passage about three members of a hypothetical plant family (Elzars) was prepared, including parallel information about each member of the plant family (e.g., soil and light requirements, leaf color, and shape). Students were to read the passage and then to go on to complete the second part of the task. On a separate sheet, a fourth member of the Elzar family was described. The students were directed to read about the fourth member and then to answer 10 questions listed below the description. These questions took the form of analogies in which the fourth member was compared to one of the original members along one of the critical dimensions of classification. Students were told that they could look back at any section of the passage that they wished to while completing the analogies.

Defining purpose for reading (Reasons for Reading). This measure consisted of a series of 10 paragraphs adapted from fourth-grade social studies and science textbooks. Following each paragraph was a series of three 'Reasons for Reading.' The students' task was to assume that they would be tutoring younger children, and that they were trying to give the younger students a purpose for reading (related to what they could learn if they read the material). Accordingly, the students were to first read a paragraph and then choose which of the three 'Reasons for Reading' they would give to a younger student. The 'Reasons for Reading' were either too general, too narrow, or appropriate. Before beginning the task, students were assured that there was no 'right' answer for these items.

Knowledge Framework Measures

In this category, there were three measures, each administered as posttests only. One concerns the schema for insect societies, another a schema for textbook organization, and the third the ability to extract superordinate units of information from prose and logically arrange them.

Insect society schema. For this measure, students were asked to imagine that they were going to teach another group of students about insect societies. In order to do this, they would have to decide which topics they would mention and what sorts of information they would include about each topic. On a prepared answer sheet they listed the topics. Next to each topic, they could list the various pieces of information they would mention in spaces provided.

Text content organization schema. For this measure, administered immediately before reading the Paper Wasp Society passage, students were asked to predict what sorts of information they would be likely to encounter in the Paper Wasp Society passage and how they thought it would be organized. On a separate sheet of paper, students identified the topics and described the organization that they anticipated finding.

Chart completion task. This measure was included to attempt to ascertain the degree to which students could (a) identify parallel elements within a passage and (b) their ability to arrange these elements in a logical form (a matrix, with row and column headings). During the posttesting period, after the students had finished with the transfer to independent reading measures, the investigator illustrated the concepts (parallelism of elements and a matrix array) using information from the "Landforms" passage. As practice, a matrix was completed on the board by the entire group. Then, students independently completed a similar chart (supplying title, row and column headings) for the "Elzars" passage, one which leant itself particularly well to representation in matrix form. The task was completed *after* students had finished the analogies task for the "Elzars" passage and the two measures designed for the "Landforms" passage.

Prior to scoring any and all of the measures, all student names were obliterated, and each piece of student data identified by a number from 01 to 72.

Scoring for the Covariates

Test of reading achievement. Fall scores for the Gates-Macginitie Reading Achievement test (Level D, 1972) were released by the district. Raw scores for Total Comprehension were used in the analyses.

Content vocabulary measure. This measure was scored according to the Anderson-Freebody formula:

$$p(k) = \frac{(p(h)-p(fa))/N}{(1-p(h))/N}$$

(where h = hits, fa = false alarms, k = known, and n = number of content words)

As application of this formula yields scores in proportions, they were later transformed using the arcsin transformation before being used for analysis.

Scoring for Knowledge Acquisition Measures

Multiple choice measures. These measures were scored right, wrong, or 'I don't know.' Various totals and subtotals were then created corresponding to either topics (food gathering across societies) or units (individual insect societies). Reliability of these measures was determined by computing Cronbach's Alpha, correcting for the 'I don't know' option. Alpha levels for the 30-item pretest and for the 60-item posttest were .03 and .87, respectively.

Daily measures. Prior to scoring these measures, a scoring key was developed for each. Keys indicated acceptable student responses, and the point values to be assigned to each response. Next, copies were made of a sample of these measures, representing equal numbers from the various treatment groups. Student papers making up the sample for any given daily measure were randomly drawn from the entire sample of 24 for each group. This sample, representing approximately 17% of the total, was used to determine interjudge reliability.

One person scored the entire sample of daily measures once. Two other people each scored a subset of the reliability sample; one scored measures for Day 1 through Day 6, and the other scored measures for Day 7 through Day 12. All scorers used the prepared Scoring Keys. To determine the reliability of the scoring procedures, correlations between the actual point assignments for each question for each of the daily measures was calculated. These correlations are shown below:

Day 1 r = .94	Day 4 r = .94	Day 7 r = .93	Day 10 r = .95
Day 2 r = .95	Day 5 r = .99	Day 8 r = .93	Day 11 r = .98
Day 3 r = .94	Day 6 r = .97	Day 9 r = .96	Day 12 r = .98

Overall, the correlations are very high, indicating that the Scoring Keys elicited highly similar classification across judges.

Once the scoring procedures had been judged reliable, a number of different scores were created from the corpus of 12 daily measures. First, for each day four scores were created: factual explanation, application, and total. Logically, the next set of scores would be those collapsed across several days to yield end-of-chapter scores, as well as total booklet scores.

To create this next set of scores, a series of proportion scores was created for each of the four categories, total, factual, explanation, and application. Since the measures had varying numbers of possible points, and since not all students were present for each of the 12 days, the proportions were

necessary in order to combine scores across days, and to use the maximum amount of data available in creating chapter and booklet scores. For instance, without proportion scores, a student who was absent for one of the four days of Chapter One could not be compared to one present all 4 days on a simple summing across Days 1 through 4.

Scoring for Transfer to Independent Reading Measures

For each of the three short answer measures in this category, the same procedures for determining reliability as were used for the Daily Measures were adopted. Correlations between two scorers for question by question point assignment for approximately 17% of the sample were .94, .96, and .97 for "Paper Wasp Societies," "The Micmac Indian Society," and "Landforms," respectively.

Once the interscorer reliability had been established as adequate, four scores were created for each passage: factual, explanation, application, and total.

For the various essay measures (noting similarities and differences, or recall), a separate set of Scoring Keys was developed. Again, correlations between the two scorers for 17% of the sample were calculated. These correlations were .86 for "Paper Wasp Societies," .87 for the "Micmac Indian Society," and .86 for "Landforms." For the two similarity and difference essay measures two scores were combined (number of similarities cited and number of differences cited) to create a score for total number of comparisons. For the recall measure ("Landforms"), a content hierarchy, assigning varying point values to text units was used to create a total point score. This system weighted the importance of the information included in the recalls. For example, a student who recalled several units at the highest level of the hierarchy received more points than a student who recalled primarily lower level units, even though the second students may have recalled *more* units than the first.

Scoring of Text Reference and Approach to Learning Measures

Insect society schema. A key was developed which identified seven major topics drawn from the lesson matrices for the instructional material, and a range of three to nine pieces of information associated with each topic. To determine reliability, a subset of the sample was first scored independently by two scorers using the key. A correlation of 0.93 was obtained. This was judged adequate and scoring of the remainder of the sample proceeded. Two scores were created for each student, the total number of topics identified and the total number of relevant items specified.

Text content and organization schema. For this measure two keys were developed, one to score the major topics and a second to identify subheadings to indicate anticipated text organization. The key to the first part isolated three levels of topic importance based on subheadings from the instructional materials. The key also distinguished between topics (signalled in the text's subtitles) which were common to all three societies (e.g., Getting Started) or specific to one society (e.g., Temperature Control in a Termite Mound). The key to the second part of this measure listed the actual subheadings in hierarchical fashion and specified whether each was common to all or specific to one society (e.g., under Keeping Going at the highest level of the hierarchy were listed Food Gathering and Nest Construction at the second level; under Food Gathering such subheadings as Gathering Nectar and Wood Eaters appeared, each specific to only one type of society).

Chart completion task. This measure was designed to ascertain the degree to which students could (a) identify parallel elements within a passage, and (b) arrange these elements in matrix form (supply row and column headings). A key was developed that indicated all possible row and column headings and students were assigned scores based on the total number of correct headings they were able to supply for both categories.

The Findings

Data analysis focuses upon the two primary categories, Knowledge Acquisition and Transfer to Independent Reading, as they correspond to the questions raised at the outset: does (a) instruction, or (b) the *type* of instruction, enhance students' knowledge acquisition or their independent reading comprehension?

Knowledge Acquisition--Contrast 1 (instruction)

The results for the analyses from this category are summarized in Table 6 and the relevant means and standard deviations presented in Table 7. Figures 1 and 2 show the pattern of means. Turning to the main effects, it is clear that School is not a significant factor, indicating that both buildings have similar patterns of results and similar outcome levels. There are, however, significant effects for Treatment Contrast 1 throughout the entire series of dependent measures for this category. Contrast 1 is always significant and strong throughout the series of regressions. Not only on the general multiple choice posttest do instructed students surpass those with no instruction (R^2 Change = .20; Total = .50), but they also do so on the more detailed daily measures (for entire Booklet, R^2 Change = .23; Total = .63). This general finding is true for types of knowledge acquired as well; students who have participated in discussion demonstrate superior performance in terms of acquiring factual information (for Booklet, R^2 Change = .17; Total = .51), explaining that information (for Booklet, R^2 Change = .22; Total = .53), and applying it in new contexts (for Booklet, R^2 Change = .10; Total = .44) when they are compared to students who have simply read the text material independently without the benefit of follow-up discussion. Furthermore, these effects are stable no matter how the various daily measures are summed to create other scores.

[Insert Tables 6 & 7 and Figures 1 & 2 about here.]

Transfer to Independent Reading--Contrast 1 (instruction)

When we turn to the question concerning independent reading comprehension, we can see that the pattern of findings is slightly different when we trace the influence of instruction (see Tables 8 & 9). For independent reading of the closely related passage ("Paper Wasps"), there is a significant effect on the short answer measure (R^2 Change = .06; Total = .41). For this same passage, however, the essay measure shows no significant effect.

On the related passage ("Micmac Indian Society"), there is a significant interaction with School. A test of simple effects showed that the effect is significant in School 1 but not in School 2 for the short answer measure. There is, however, an effect on the essay measure (R^2 Change = .06; Total = .26), contrary to the findings for the comparable measure for the closely related passage.

In examining the results of reading comprehension of the unrelated passage ("Landforms"), it is apparent that the effect of instruction has disappeared for both the short answer and the recall measures. When the material is unrelated to that of the original instruction, the instructed groups no longer have the advantage over the uninstructed groups. As will become apparent in the analysis for Contrast 2, however, this effect is attributable to the low scores obtained by the Discrete group.

[Insert Tables 8 & 9 about here.]

Knowledge Acquisition--Contrast 2 (type of instruction)

As Table 6 shows, in several instances there was a significant School X Treatment Contrast 2 interaction. Results of tests of simple effects revealed that while Integrative is superior to Discrete in both schools, the difference is more pronounced in School 2 than in School 1.

In terms of the total amount of knowledge acquired over the entire instructional cycle, there is a significant effect for type of instruction in both schools, although the size of the effect is much greater in School 2 than in School 1 (R^2 Change = .07 (S1); .35 (S2)). The Integrative group demonstrates performance that is superior to that of the Discrete group. This finding is mirrored in the results of the multiple choice posttest, again covering the entire instructional unit (R^2 Change = .06; Total = .50).

If we consider the kinds of knowledge acquired, the findings indicate that students in the Integrative group show higher levels of factual knowledge than their peers in the Discrete group; they also show greater facility in constructing explanations and in applying their knowledge to new contexts, particularly for School 2. In School 1, although it is not as consistent, nor as strong, the same pattern between the two forms of instruction emerges.

Transfer to Independent Reading--Contrast 2 (type of instruction)

For the closely related passage ("Paper Wasps"), there is a strong effect for type of instruction (Short Answers: R^2 Change = .19, Total = .41; Essay: R^2 Change = .26, Total = .37), indicating a distinct advantage for the Integrative form of instruction (see Table 8). Again with the second passage ("Micmac Indian Society"), there is a strong effect for type of instruction on both kinds of measures: the advantage of the Integrative group is maintained (Short Answers: R^2 Change = .18; Total = .63; Essay: R^2 Change = .16, Total = .26).

On the last passage in the series, "Landforms," there is a clear effect for the form of instruction (Short Answers: R^2 Change = .08, Total = .33; Recall: R^2 Change = .07, Total = .33). Students who participated in the Integrative form of instruction demonstrate higher levels of reading comprehension than those who participated in the Discrete form, even when the material bears no relation to that originally discussed. In addition to enhancing students' knowledge acquisition in the domain of instruction, the Integrative form of instruction also influences some aspect(s) of comprehension that cannot be traced directly to content knowledge. Recall that the Landforms effect was not significant when the two instructional groups were compared to the Independent Reading group. An inspection of adjusted means (Table 8) for the three groups reveals that the change in significance between Contrast 1 and Contrast 2 is due to the fact that the mean for the Discrete group is lower than that for the Independent Reading group. Figures 3-5 show the pattern of group differences for the transfer passages.

[Insert Figures 3-5 about here.]

Secondary-Categories of Dependent Measures

The results of the analyses of measures in the remaining three categories are not as straightforward as those for the primary categories. Earlier it was stated that the unreliability of the approach to learning measures precluded further analyses. For the Text Reference measures, there are scattered effects for instruction and for type of instruction (favoring the Integrative form), but no clear and consistent pattern emerges. Consequently, it is not possible to explain the positive effects observed in Knowledge Acquisition or in Transfer to Independent Reading by differences in the students' text reference skills or in their fundamental approach to learning, at least as measured by the instruments used in this study.

Differences in Knowledge Framework measures (e.g., students' acquisition of a schema for insect societies, their schema for text content and text organization) do emerge; while there is no effect for instruction, per se, on these measures, there is an effect for type of instruction, with the Integrative group demonstrating more fully developed knowledge structures than the Discrete group (R^2 Change = 0.37; Total = .40). Further, the Integrative group is better able than the Discrete group to extract superordinate units from text and arrange them in a fashion that displays their logical relations to one another by indicating row and column headings for a matrix chart (R^2 Change = .19; Total = .31).

The regression effects and the means and standard deviations for the measures in this category are presented in Tables 10 and 11.

[Insert Tables 10 & 11 about here.]

Summary of Findings

The results of Study 2 largely support and extend the findings of Study 1. In accordance with the conviction of many teachers, discussing new content with children more readily enables them to acquire it than if we simply assign new content as independent reading. Further, students' grasp of this new content is not limited to recall of factual information, but extends to include a greater proficiency in constructing explanations and applying knowledge in new contexts. Additionally, students who participate in discussion of text content can use their acquired knowledge to enhance their independent reading of passages related to some degree to the originally discussed material.

The results of Study 2 also indicate that differences in the form of a follow-up text discussion influence the knowledge acquisition of students *and* their independent reading. While either of the two forms is more facilitative than no instruction, the Integrative form led to greater knowledge acquisition and further transfer to independent reading than did the Discrete form of instruction. Students who participated in the Integrative form acquired more knowledge of all types (factual, explanation, and application), demonstrated superior independent reading comprehension of both related and unrelated passages, and were better able to predict and describe the structure of novel passages.

Discussion

The results of Study 2 offer clear evidence that instruction significantly enhances students' knowledge acquisition and their independent reading of material related to some degree to that of the original instruction. This leads us to conclude that, since students profit so substantially from instruction, their independent reading skills for informational texts are relatively weak, and that this constitutes an instructional problem of considerable importance and magnitude for both teachers and students.

Since the Integrative form of instruction led to superior knowledge acquisition and independent reading comprehension when compared to the Discrete form, we can conclude that *what* the teacher does significantly influences students' performance. Not all forms of instruction are likely to be equally effective.

Although the findings of Study 2 yield a clear indication of the general efficacy of Integrative instruction when compared to Discrete instruction, they offer no satisfactory explanation as to *why* this instruction was more effective. Since the attempt to elucidate the reasons for the differential effectiveness of these two types of instruction through the analysis of the secondary categories of dependent measures was not successful, a third study was undertaken which *manipulated* rather than *assessed* some of the critical features of integrative instruction.

STUDY THREE

The instruction designed for the Integrative group in Study 2 was developed by superimposing two quite distinct features, visual representation of text content and systematic reference to the text, on a pre-determined content structure plan that guided the teacher's treatment of the text content during discussion. These features acted in concert to support the teacher's attempt to highlight important relationships in the content, one through visual means and the other through verbal means.

In Study 3, the approach was to isolate these two features in order to determine which of the two, if either, produced the effects associated with the Integrative form of instruction observed in Study 2. The effects of most concern to account for were those associated with knowledge acquisition, transfer

to independent reading of related and unrelated content, and the acquisition of generalized knowledge structures associated with the content domain and with texts.

Not all of the positive effects observed in Study 2 need necessarily have been associated with one or the other feature. Rather, some kinds of effects might be associated with one feature and others with the second feature. Generally, those effects most closely linked to the content of the instructional material might more plausibly stem from the incorporation of the visual representation feature, while effects relating more to text, per se, might stem from the incorporation of the text reference feature. Hence, it is plausible to expect that a treatment focusing exclusively on Visual Representation might exceed one focusing on Text Reference on (a) the Knowledge Acquisition measures, and (b) the Transfer to Independent Reading (related content), (c) Acquisition of an Insect Society Schema measure, and (d) the Matrix Chart Completion task (supplying row and column headings). The treatment incorporating Text Reference, on the other hand, might lead to superior performance on (a) Independent Reading of unrelated content, and (b) Schema for Text Organization, and to a lesser extent, the Chart Completion task.

Method

Subjects

Subjects for Study 3 were 24 fourth-grade students drawn from one intermediate level school (grades 4 through 6) in the same district as the two schools in Study 2. As did subjects in Study 2, all students in Study 3 came from self-contained classrooms. Procedures for the assignment of subjects to one of two treatment groups were identical to those used for Study 2. Eight students from each of three participating classrooms were randomly selected and assigned to treatment group.

Instructional Treatment Groups

The treatments for the two groups of Study 3 were designed using the Integrative form of instruction of Study 2 as a reference point. One treatment incorporated the Visual Representation feature and the other the Text Reference feature of the Integrative instruction from Study 2. As was true for Study 2, the design for both groups in Study 3 entailed superimposing one of the features on a pre-determined content structure for the material. Lesson plans for both groups shared the same content structure but differed with respect to which of the two features of the Integrative form was incorporated.

Plans for the Visual Representation group were developed by eliminating all the explicit text reference direction from the plans used for the Integrative group in Study 2. The teacher gave no explicit indications to students as to the appropriate sources for their contributions to discussion. Students were not prevented from looking back at the text; they were simply not explicitly directed to do so.

Plans for the Text Reference group were also modeled on the Integrative instruction of Study 2. The content structure and treatment of content remained the same, but the use of all visual representations of the content was eliminated. The plans retained the direction to students to support contributions by locating specific text information and reading it aloud. Also retained was the provision for extra guidance and support for students through teacher modeling of effective behavior to help them learn how to locate relevant information more efficiently.

Materials

The materials of Study 3 were identical to those of Study 2 with the exception of the lesson plans. The lesson plans consisted of the two variants of the Integrative plans for Study 2 just described. The *Insect Societies* booklet again constituted the instructional material for the Visual Representation group.

Three of the five categories of dependent measures from Study 2 were again employed in Study 3: Knowledge Acquisition, Transfer to Independent Reading, and Knowledge Frameworks. All scoring procedures were the same for both studies. Reliability was calculated for each measure only once, pooling subsets of protocols from each study; consequently, the same reliability levels described for Study 2 also apply to Study 3.

Procedures

As closely as possible the procedures for Study 3 replicated those of Study 2. An unused classroom was made available for use in Study 3, and both groups used this room for regularly scheduled class sessions.

As in Study 2, students were tested by classroom rather than by treatment group; the pretesting period was again 3 days with a 2-day orientation, and the posttesting period 5 days.

Design and analysis. The design of Study 3 is simpler than that of Study 2 with the factor of school eliminated and only one treatment contrast, that between the two instructional features, visual representation and text reference.

Precisely the same basic analysis plan developed for Study 2 was adopted for all the analyses of Study 3. Working again within a hierarchical regression framework, each dependent measure was first evaluated for covariate X treatment contrast interactions. There were no such interactions. Subsequently, a two-step regression analysis was carried out for all dependent measures following the same progression:

STEP

1 Reading Ability
Content Vocabulary

2 Treatment Contrast (Visual Representation/Text Reference)

3 Reading Ability X Treatment Contrast Interaction

4 Vocabulary X Treatment Contrast Interaction

Results and discussion. For the first category, Knowledge Acquisition, there are few significant differences between the two treatment groups, despite a general pattern of higher means for the Visual Representation group compared to the Text Reference group. The end of unit total score (collapsed across all three types of knowledge) for the daily measures showed significant effects. The Visual Representation group acquired more knowledge than the Text Reference group, but only slight differentiation as to type of knowledge is possible (for example, on total Booklet, R^2 Change = .09, Total = 0.60; $F(1,20) = 4.37$; $p < 05$.). In terms of type of knowledge, the Visual Representation group was superior on the explanation questions (R^2 Change = .15; Total = 0.62; $F(1,20) = 7.73$; $p < .025$).

[Insert Table 12 about here]

The results of the regression analyses for measures in the second category reveal that there are no significant effects throughout the entire series. In short, there is no evidence of carry-over of the effects of acquired knowledge to reading comprehension of related material as there was in Study 2. The Visual Representation group performed no differently on any of the reading comprehension measures than did the Text Reference group, despite some indication of superior knowledge acquisition.

The results of the regression analyses for the final category, Knowledge Frameworks, again reveal that there are no significant differences between the two treatment groups. We are not able to distinguish the two forms of instruction of Study 3 in terms of generalized knowledge effects as was possible in Study 2.

To summarize, the results of the analyses from Study 3 do not allow us to trace the effectiveness of the Integrative instruction of Study 2 to one or the other of the supporting features. Before concluding that there are, in fact, no differences between these two forms of instruction, however, we must note the small sample size and the relatively low power (less than .30) of the F-tests. Although there may, in fact, be no significant differences between the two treatments as the regression analyses largely indicate, we must regard these findings with caution.

Post Hoc Analyses

Setting aside the question of the relative superiority of the two features, there are several other questions which can be addressed if we look across the contrasts in both Studies 2 and 3. A new set of contrasts was created by examining the entire array of different treatments from both Study 2 and Study 3. They were: (a) *Instruction*: Instruction/No Instruction; (b) *Content Treatment*: Integrative Treatment/Discrete Treatment; (c) *Supporting Features*: Two Features Combined (Integrative of Study 2)/One Feature Only (each of the two treatments in Study 3).

A series of post hoc regression analyses for a subset of the dependent measures was carried out controlling first for the two covariates and then evaluating the significance of the treatment contrasts. In the first category, Knowledge Acquisition, each of the unit scores showed a significant effect in the expected direction for all three contrasts. Students who had the benefit of some instruction in the form of a follow-up discussion acquired more knowledge than those students who simply read the material independently. When the teacher's treatment of the content was essentially integrative rather than discrete, students acquired more of the content. Finally, instruction which incorporated both the Visual Representation and Text Reference features proved superior to instruction which incorporated only one of those features. Figure 6 displays the differences between all five treatment groups.

[Insert Figure 6 about here.]

For the second category, Transfer to Independent Reading, the short answer measures were analyzed. For the two passages related to the original content, all three contrasts were again significant, but, for the last passage, only the second contrast, Content Treatment (comparing the Discrete to the Integrative treatment), was significant. Although the critical control condition was not represented (integrative content structure with no supporting features) in these contrasts, the results are still strongly suggestive of the general efficacy of an integrative approach to novel text content when it is compared to a discrete approach.

GENERAL DISCUSSION

The purpose of this series of investigations was to learn more about textbook-centered learning in the content area classroom. In particular, knowledge acquisition was studied as a function of teacher-directed attempts to foster the comprehension of specific text content, possibly also leading to transfer to their independent reading comprehension.

In the remaining sections of this paper, the major findings from the three studies are reviewed in summary form; then the findings are discussed, within the limitations of this series of studies, in terms of their implications for the broader concerns of practice. Three issues in particular are discussed in some detail: (a) students' independent reading of novel content, (b) the consequences of prevailing practice, and (c) the consequences of the experimental alternative to prevailing practice.

Review of the Findings

The findings concerning the influence of instruction on students' knowledge acquisition are quite consistent. In comparison to the uninstructed group, the instructed groups in both Study 1 and Study 2 acquired substantially more knowledge. Not only did instructed students acquire more knowledge, they were better able to construct explanations using that knowledge and to apply it in new contexts. The magnitude of these effects was strong and consistent throughout the series of knowledge acquisition measures. Further, students who participated in some form of instruction demonstrated transfer of acquired knowledge on tests of independent reading of material that was related to that of the original instruction superior to that of students who received no teacher assistance. Again, Study 2 confirmed the main findings and trends of Study 1 in a strong and consistent fashion. Instruction enhanced students' acquisition of knowledge and facilitated their independent reading comprehension of related material.

The findings also demonstrated that the form of instruction influenced students' knowledge acquisition and their independent reading. Students who participated in the Integrative form of instruction not only acquired more knowledge overall than students in the Discrete group, they also were better able to construct explanations using that knowledge and to apply it in new contexts. Additionally, participation in the Integrative form of discussion led to superior transfer to independent reading, of both related and unrelated content.

The findings from Study 3, which was designed as a follow-up to Study 2, yielded two sorts of information. One sort concerned the relative contributions of each of the supporting instructional features, Visual Representation and Text Reference, to the overall effectiveness of the Integrative form of instruction in Study 2; the results of Study 3 do not allow us to determine with any confidence the sources of relative effectiveness. Post hoc analyses suggested, however, that the Integrative form of instruction of Study 2 which incorporated both features was more effective than instruction incorporating either one alone. Further, the post hoc analyses suggested that any of the variations on the Integrative form of instruction were more effective than the Discrete form, both with respect to knowledge acquisition and transfer to reading comprehension of new texts. What appears to be warranted is an additive interpretation of these two features. Each by itself is equally superior to no instruction, and the two together are about twice as effective as either by itself.

Limitations

Before considering the issues related to actual practice, the limitations of this series of investigations should be acknowledged. These include the vulnerability of all the investigations to bias in the data collection procedures, the group size for instruction, the varying amount of time available for each treatment group, the closeness of the approximation of the Discrete form of instruction to actual practice, the similarity between the experimental texts and commonly used school textbooks, and possible systematic differences that might distinguish the teaching of the experimental teacher from that of classroom teachers.

Although all of these limitations bear on the interpretation we give to the findings concerning each of the three issues outlined above, some have more relevance to one than another. For this reason, with the exception of the question of bias, each limitation is discussed at greater length within the context of its greatest relevance. Since possible bias in the data collection procedures stemming from the fact that the investigator delivered all the instruction and administered all the tests is a general issue surrounding the interpretation of all the results, it is discussed first.

Because this set of studies involved the evaluation of instruction, potentially it carries implication for the practice of classroom teachers and the training of new teachers. Taking this potential seriously requires that those who carry out instructional studies proceed cautiously.

Having many teachers carry out the experimental procedures in the course of their on-going instruction is clearly the most ecologically valid, and most readily generalizable, approach. However, at initial stages of instructional research, as was the case here, there are two primary obstacles to using classroom teachers. One is the difficulty in persuading a large enough number of teachers to substitute an experimental approach for their normal practice when they have no evidence that it is at least as effective as what they are already doing. A second difficulty stems from the likelihood that allowing the teacher factor to vary in random and/or uncontrolled ways will decrease the statistical precision and power of the experiment. In the early stages of a line of instructional research, it is more "cost-effective" to err on the side of statistical power (an internal validity issue) than generalizability (an external validity issue). Also, in the early stages of such research, it is unlikely that relevant sources of teacher variation will be known, or, even if they are known, that there will be reliable ways of measuring such sources so that they may be controlled statistically.

For the present investigations, both sorts of difficulties were present at the outset. There was no basis for attempting to persuade teachers to carry out the experimental procedures and abandon their own. And, although relevant literature is available to help identify likely sources of variation (those, for example, stemming from the materials, group size, teacher years of experience, or building SES level), we do not yet know how to measure some of them. For instance, if teachers could be persuaded to use the Integrative form of instruction, there would still be the question of the materials--how great a range would there be in terms of topic, familiarity, length, or considerateness? Using materials prepared by the investigator is not necessarily a desirable course for teachers as they must then eliminate part of the regular curriculum.

Additionally, there is the possibility that wide variation would stem from teacher differences. Although the teacher behavior of interest in these studies was restricted to the development and delivery of plans for discussion of text content, there are at least two other aspects of teaching that are probable sources of variation: the teacher's own content knowledge relevant to the domain of the students' inquiry and the teacher's manner of interacting with students during this kind of instruction. Both of these factors may influence the fidelity with which the teacher delivers lessons.

Several efforts were made to minimize potential bias in these studies: (a) testing students by classroom rather than by treatment group, (b) delaying the scoring of the daily measures until all instruction had been completed, (c) obliterating all names and replacing them with numbers on students' papers, and (d) collecting video tapes of all instructional sessions. Nonetheless, the essential vulnerability to bias, particularly in conducting the discussions, still remained. The possibility of bias in the data collection procedures must therefore be acknowledged, but in the present case of instructional research in its initial stages, it is acknowledged without apology.

In considering each of the three more general issues outlined earlier (i.e., independent reading of novel content, the consequences of prevailing practice, and the consequences of the experimental alternative), we have information about each *relative* to the others. Although the a priori contrasts tested in the principal analyses provide a good deal of substantive information, they do not tell us about the relative effectiveness of either form of instruction when compared to students' independent reading. With the exception of the final transfer passage results ("Landforms"), the means of the three groups preserve the same ordering: Independent Reading < Discrete Instruction < Integrative Instruction. To gain a sense of these differences, effect sizes were estimated using the adjusted means. These results are shown in Table 13.

[Insert Table 13 about here.]

Independent Reading of Novel Content

Although content area reading is generally considered to be "difficult" for a variety of reasons (including unfamiliarity with discourse type, unfamiliarity of content, lack of appropriate study skills),

currently there is little evidence to document the scope of the problem, if indeed there is one. We know something about students' independent reading of single brief passages, but we know very little about their comprehension of larger units, spanning the length of a textbook chapter on one topic. The results of both Study 1 and Study 2 offer clear evidence that students have trouble with this sort of independent reading; they profit substantially from teacher assistance. As Table 5 indicates, students in either one of the instructed groups acquired more knowledge about the domain of insect societies than did students who simply read the material independently. Before concluding that all content area reading is apt to be problematic, we can attempt to qualify the general finding of the present series of investigations: Do we have any information about the conditions under which this type of reading is apt to be difficult?

Before proceeding further, we must return to the earlier observation about the discrepancy in the total amount of time available to each treatment group. Students in the Independent Reading group spent approximately 15 minutes with the text material, while students in the two instructional groups spent approximately twice that, or 30 minutes.

Students in the Independent Reading condition were allowed as much time as they wished; as it happened, they did not ask for longer than 15 minutes. Some students used the available time to read the material more than once; others read very slowly. Still others finished comparatively quickly. As no formal records were made of students' use of time over the course of these studies, it is not possible to estimate either the extent or the consequences of this variation.

While students were free to ask for assistance in pronouncing words, and did so, it is worth noting that at no time did any of the independent students ask whether or not they could underline portions of the text, or take notes. This brings us to a consideration of the differences, if any, between reading and studying text, and equally importantly, the students' awareness (or lack thereof) of these differences.

Assuming for the moment that there is a difference between reading and studying and that the instruction fostered improved studying rather than reading behaviors, we must acknowledge that the comparison between the instructed and uninstructed students may not be entirely appropriate. Had students in the independent group been given feedback about how they were doing on the daily measures and an opportunity to discuss more effective strategies for improving their performance, they might have been able to induce more effective study skills. This, of course, is an empirical question and can be explored in future work.

A final comment about the appropriateness of the comparison between instructed and uninstructed students concerns the assessment of transfer to independent reading. For all three transfer passages, students in all treatment groups engaged in independent reading under precisely the same conditions that obtained for the Independent Reading group during the intervention period. While one may argue that a bias toward the instructed groups may have existed for the knowledge acquisition measures, no such argument can be raised for these transfer measures; hence the interpretation of existing group differences favoring instruction (especially Integrative instruction) is straightforward.

Returning now to a consideration of the conditions under which independent reading of novel content is apt to be difficult, it is important to examine the materials. Although the comparability of the materials is an issue for the instructed groups as well, it is particularly important for the independent reading group. How do these insect society materials compare with other materials fourth-grade students are likely to encounter during instruction? Is there any reason to believe that these materials are any more or less difficult than others they may encounter? As noted in the description of Study 2, the readability levels, using both the Dale-Chall formula and the Fry formula, were calculated for each section of the Insect Societies booklet. These results are shown in Table 5. As Table 5 indicates, there is a range, using either formula, of grade 4 to grade 8. Earlier, some of the problems of using these formulas with expository material were discussed, with the suggestion that estimating actual difficulty through the use of these formulas was probably not feasible (Cohen & Steinberg, 1983). In preparing

the materials, then, a decision was made to allow readability level to vary, but to attempt to control section length.

At the conclusion of the study a follow-up analysis was carried out on the various elements of the readability formulas and their relationship with major dependent measures. Allowing for the possibility that any relationship might differ with instructional treatment, separate analyses were carried out for each of the treatment groups of Study 2, as well as for the overall sample.

The predictors of readability included section length and, from the Dale-Chall formula (Dale & Chall, 1948), words per sentence, number of unfamiliar words, and the Dale-Chall score. For the Fry formula (Fry, 1968) the predictors included were number of sentences and number of syllables per 100 words. The set of simple correlations between predictors and group means reveals a strong association between section length and number of unfamiliar words with each other ($r = .25$) and with the set of group means. In no case, however, did either of these predictors or any of the others explain a significant amount of variance in any of the group means. Longer passages then, are associated with higher levels of unfamiliar words, and both are associated with lower means on the outcome measures, although the association is not statistically significant.

Length is probably the more reliable measure of difficulty since the Dale-Chall unfamiliar word counting procedures allow for no correction for recurrences of the same word throughout the series of passages. In effect, this serves to inflate the unfamiliar word scores (Cohen & Steinberg, 1983). Further, since the unfamiliar words are apt to name concepts, attempting to reduce difficulty by replacing them with more familiar synonyms (if available) might adversely affect the precision of the original language and/or add additional verbiage to explain concepts for which no familiar word labels are available.

The average passage length for these materials is 540 words. The question of interest then is how this compares to the amount of content typically covered in normal practice. For this we have only indirect evidence from some of the observational work described at the outset. Teachers reported in the Gallagher and Pearson (1982) study that they normally spent 2 to 3 weeks covering one textbook unit, which usually was a chapter. Estimating chapter word count to range between 4,000 to 8,000 words, depending on publisher, the amount of content covered in this study is within the normal range.

The only other index available from the present set of data is one of the degree of novelty represented by the instructional materials. Reasoning that students may already know more about some domains than others, and that materials about the more familiar domains are likely to be "easier," coupled with the important role prior knowledge has been observed to play during the comprehension process (Johnston, 1981), novelty presents itself as a reasonable index of difficulty. Using the multiple choice pretest performance as an index of novelty we can conclude that the instructional material was indeed novel; pretest means were near chance. Again we can ask whether students are apt to encounter a comparable degree of novelty in normal practice. Unfortunately, we are unable to answer the question; consequently we must be content to qualify the general finding of the present work by suggesting that when students encounter material of a high degree of novelty, they benefit substantially from teacher assistance. Whether or not the same advantage would accrue with less novel material is still unknown.

One final observation about the relative difficulty of the instructional materials concerns their considerateness--how transparent they render the underlying conceptual structure of the knowledge domain. In the preparation of these materials, care was taken to ensure that they were good examples of informational text; in short, the objective was considerateness. In the Brooks and Dansereau (1984) work cited earlier, the authors report a facilitative effect for text organized according to the underlying structure of the knowledge domain. Interestingly, the facilitative nature of considerate text does not, in their work, depend on training in the recognition of that structure; students working on their own benefited from considerate organization to the same extent that trained students did. In the present

study, we can observe that when the instructional materials included considerate text, instruction enhanced performance. What the Brooks and Dansereau findings lead us to suggest further, however, is that in comparison to other materials students may encounter, the relative difficulty of those used in this study stemming from length or novelty might be offset by their level of considerateness.

To summarize then, we can conclude that the present set of findings strongly suggests that fourth-grade students profit greatly from teacher assistance in coping with their content area textbooks. Acquiring knowledge solely from text is difficult. By extension, enabling students to use reading skill as a tool for knowledge acquisition represents an instructional task of considerable proportion and importance.

Prevailing Instructional Practice

From these results, we know that in comparison to a Read Only control group, the Discrete form of instruction enhanced students' performance, particularly in terms of the amount and kind of knowledge they acquired. In extending these findings to commentary on prevailing instructional practice, we should consider carefully several of the issues that may affect generalizability. First is the question of how closely the Discrete form of instruction actually approximated classroom practice as we described it at the outset. In attempting to do this we are hampered by the paucity of careful description of practice that relates the verbal exchange to the text material being discussed. Only the Smith and Geoffrey (1968) work begins to tie the two together, and even in this work, we do not have an example of an entire text being discussed for the whole of one lesson; instead, we have data only for brief segments.

The Discrete instruction, modeled on descriptions of conventional practice, probably resembles it in broad outline, but not in every particular. In the course of on-going practice, teachers can be expected to deviate in particular ways from the format used here, some of the time. What probably will not change, though, is the real limitation placed on teachers when the first decision is to introduce topics according to order of presentation in the prose without any provision for differential emphasis. The Discrete form of instruction then, is probably best characterized as a close approximation to much of conventional practice.

A second issue is group size. Content area instruction at the elementary level is ordinarily delivered to the whole class rather than to smaller groups, as was the case in these studies, although the heterogenous composition of the whole class was preserved. Since there is substantial evidence that group size does influence instruction in many ways (Dunkin & Biddle, 1974), the small group size of these studies represents a serious threat to the external validity of the current findings. We simply cannot predict whether or not the same pattern of findings would occur with whole classes.

A third issue is materials. Would the same pattern of findings obtain with more or less considerate, interesting, or novel materials? Again, we cannot resolve these questions based on the present work; we can only raise them as constraints on the interpretation of the current findings and areas for future exploration.

Despite the limitations mentioned, the results do indicate that instructional practice that resembles the Discrete form of instruction will enhance students' performance when compared to allowing students to work on their own, but not when compared to instruction fostering integration across text segments. In attempting to understand why students who participated in the Discrete form of instruction acquired more knowledge than students who simply read the material independently, we can cite the fact that the oral reading during class constituted, in effect, a re-reading. Further, the focus on one paragraph at a time may have sufficiently narrowed the focus for students so that they could attend to specific factual information. In fact, the Discrete form of instruction affords students a high degree of redundancy of text information. This, coupled with the fact that the independent readers had neither the advantage of redundancy nor the possibly clarifying value of a group discussion with their peers, may account for the observed differences in factual knowledge acquired.

It is less clear how to account for the differences in students' abilities to construct explanations and to apply their knowledge in new contexts. It may be that the latter two depend to a large extent on a firmer grasp of factual knowledge than the independent readers were able to gain. Similarly, comprehension of related material ("Paper Wasps" and "The Micmac Indian Society"), may depend in part on a firm grasp of relevant factual information. When the passage was about unrelated content ("Landforms") the differences between the Discrete group and the Independent Reading group disappeared. What students gained from the instruction did not extend to comprehension of unrelated material.

To summarize then, we can, within the limitations already discussed, conclude that conventional instructional practice, represented by the Discrete form of instruction in these studies, substantially enhances students' knowledge acquisition, when they are encountering novel content. Further, the effectiveness of the instruction extends to students' independent reading of material about content related to that of the original instruction. In many respects then, the prevailing instructional practice in content area classrooms has positive effects. Teacher assistance helps students acquire more knowledge to a degree sufficiently firm to enable them to use it during independent reading of related material. The prevailing practice may not be as effective as the Integrative form; however, it is certainly superior to leaving the students "on their own."

Experimental Instruction--Integration

As we have seen, when students have little prior knowledge, the teacher's approach directly influenced students' knowledge acquisition and independent reading comprehension. Why?

Students who participated in the Integrative form of instruction experienced exposure to the text content designed to heighten their awareness of the interrelationships among the concepts both within and across separate segments of text while at the same time attending to factual detail relevant to important concepts. The teacher organized discussion to highlight important relationships and reinforced it by providing a visual representation. In contrast, the Discrete form offered exposure to text content that was essentially serial or list-like. Proceeding through the text one paragraph at a time added nothing to the properties of the prose itself. Students in the Discrete group could benefit, then, to the degree that they themselves were able to induce and use structural elements relating to insect societies in general.

While the Discrete form of instruction did provide a high degree of redundancy, the Integrative form still led to greater knowledge acquisition. Recalling our earlier discussion of knowledge acquisition processes, a plausible explanation is that the Integrative form helped students modify or create a framework for organizing and relating the information they encountered while the Discrete form did not. It is further possible that the Discrete form, through the practice of breaking up the information into small units, actually interfered with students' attempts to build frameworks, perhaps even inhibiting the potentially facilitative nature of the prose itself. So that, even though the prose was well structured, the Discrete form of instruction may have prevented students from taking advantage of it.

Some of the post hoc analyses of Study 3 support this interpretation. Comparing all the groups based on the Integrative plan for topic introduction and discussion to the Discrete form, the Integrative plan groups perform at higher levels than the Discrete group. This suggests that the integration of main concepts intrinsic to the plan is itself a strong factor in students' learning.

Earlier, the very low pretest means were mentioned. This meant that a range of knowledge levels, from low to moderate to high, did not characterize students' prior knowledge. In other domains, this might not be the case. Had there been a range of knowledge levels, as one would expect in most content area classrooms, it is not at all clear from these findings whether or not the same pattern of results would have been apparent. If the most important aspects of the Integrative treatment were its potential for highlighting relationships between important concepts and for creating a framework for

interpreting information, it might not be as effective when students already possess the appropriate framework, i.e., when the topic is "familiar."

In other words, when prior knowledge levels are higher, so, too, is the structural completeness of the knowledge framework or schema that represents it, and hence the students might be less in need of assistance from the teacher. For students with high levels of prior knowledge, then, the considerate organization of the prose itself, coupled with the explicit exposure of factual detail in the Discrete form of instruction might be equally as effective, if not more so, than the Integrative form. Of course, when speaking of underlying representations, we must be careful to point out that the structures that we have described reflect both *text* content and the organization of *discussion* topics. Both in turn reflect the underlying conceptual structure (at least to some degree) of the knowledge domain itself. In fact, one thing that became clear in conducting these studies was that this knowledge structure may *not* be independent of text structure in any important way. It may, however, be at best only a close approximation to the *individual's* underlying knowledge structure; they are by no means necessarily identical. What the teacher in the Integrative form of instruction provides is a framework for students to use that may coincide closely with the student's already existing schema, may bear some resemblance or no resemblance to an already existing schema, or may necessitate the creation of an entirely new schema for the student.

A comparison of the findings from Study 1 and Study 2 provide some pertinent information. In Study 1, there *was* a greater range of prior knowledge levels represented. It was possible then for knowledgeable students to benefit from the Discrete instruction more than less knowledgeable students. But, there was no prior knowledge by treatment interaction, at least for a relatively brief instructional period. Although the brevity of the instruction (limiting the number of occurrences of the overall insect society structure) should not be minimized, the fact that there was no prior knowledge by treatment interaction in Study 1 suggests that even for more knowledgeable students, Discrete instruction may be less facilitative than the Integrative.

One of the principal reasons, then, for the facilitative effects of the Integrative form of instruction may be that it provided an organizing framework for students. Precisely how such a framework influences knowledge acquisition is not clear, however, and we must further qualify our conclusions with the recognition that this particular pattern of results may apply only to situations when the information that students encounter is truly novel to them and when the instructional cycle is at least 2 weeks long.

The results of the analyses of the Insect Society Schema Acquisition measure from the Knowledge Frameworks category suggest that, at least for the domain of insect societies, students in the Integrative group developed schemata that more closely coincided with the overall structure of the instructional material than did students in the Discrete group, lending some credence to a "framework facilitation" interpretation.

To conclude our comments about the experimental instruction, some discussion of the two supporting features of Integrative instruction (visual representation and text reference) is in order. Since the visual representations closely paralleled the text organization and the underlying conceptual structure, the Text Reference feature may have helped students recognize the fact that important column or row headings on a visual representation organized in matrix form corresponded to subsections of the prose. Further, as students went back to the text to clarify or verify various points during the discussion, their awareness of this correspondence may have been reinforced. So, at the level of passage and unit structure, the combination of the two features may well have been mutually reinforcing in helping students to see overall structure and how the text presentation reflected that structure. The superior performance of the Integrative group on the Predictions of Text Organization in the Knowledge Frameworks category lends support to this interpretation.

Together, these two features helped to shape lessons that had very concrete activities to purposefully engage students (creating and filling in a chart) and a manageable strategy for participating in these

activities (referring to the text). How coherent and manageable instruction seems to students is always a concern, but may have been especially important in this study, when a novel form of instruction was being compared to one that followed a very familiar and predictable format.

Transfer to Independent Reading

Previously we observed that the Discrete group's independent reading comprehension demonstrated a firm enough grasp of the instructional material to influence their comprehension of related material. The Integrative group demonstrated superior comprehension on both the Paper Wasps and the Micmac Indian Society passages. One could argue that the transfer to these two "schema-related" passages reflects the fact that the Integrative group developed a stronger "society" schema than the other groups did. This explanation cannot, however, account for their superior performance on an unrelated passage ("Landforms"). What advantage have these students gained that is not strictly content-dependent?

Two characteristic practices of the Integrative form of instruction may help to answer this question, the preparation for silent reading and the systematic reference to the text. Each day, before students read the text, they were given an orienting question by the teacher. Discussion commenced with the students' comments on whether or not they had found some pertinent information in the text. As the instruction progressed, students began to generate their own questions before reading, most often using transparencies showing related content to help them formulate questions. Additionally, the teacher directed them to look at the sections of the text to get an idea of the sorts of information that they would encounter, and to relate that to previously covered material. So, each day, as students read the material silently, they were doing so with a specific purpose and with an awareness of the major topics present in various subsections as they related to their purposes. In contrast, although the students in the Discrete group had just as much practice in silent reading, they read without help in defining their overall purposes or in detecting the organizational structure of the text. Instead, they had purposes specific to each text section without reference to the entire accumulation of material.

In this regard it is disappointing that the Approach to Learning measures provided no useful information. Since they were designed to assess the kind of content-independent behaviors that we are interested in, they might have furthered our understanding of the ways in which the Integrative treatment fostered independent reading skill. Nor can we turn to the Text Reference measures, since there are no differences favoring the Integrative group. There are two measures from the Knowledge Frameworks category, however, that suggest that the Integrative treatment fosters students' abilities to detect and use the superordinate structure of the text that might in turn enhance their independent reading. The fact that students could predict the organization of a new text, together with their ability to extract superordinate information from a text in order to label the rows and columns of a matrix chart, suggests that the Integrative treatment did indeed sensitize students to the way in which the overall organization of any text can reflect the underlying conceptual structure of the knowledge domain.

An unanticipated consequence of adopting the Integrative form of instruction was that some students began to use their Study Guides to organize spontaneous notetaking during silent reading toward the end of the instructional period. They then contributed to class discussion on the basis of the notes they had taken. This suggests that for some students at least, reading had become highly purposeful, involving attention to detail within a superordinate framework, in a way that they could themselves control. This type of behavior may have carried over to independent reading.

Taken together, the comments we have made about the reasons for the effectiveness of the Integrative treatment in fostering both knowledge acquisition and independent reading comprehension suggest that it is a constellation of features that operated to foster different aspects of both the knowledge acquisition and the comprehension process. And it is the collective impact of the entire constellation that produced the facilitative effects rather than any single feature.

Reasons for the Persistence of Prevailing Practice

Having discussed the variety of ways in which the Integrative form of instruction is more effective than the Discrete form, and some of the probable sources of this effectiveness, we should be in a position to make some suggestions about practice. But, without considering some of the reasons for the persistence of conventional practice and some impediments to changing it, such suggestions would be premature, if not altogether misplaced. Indeed, it was through listening to teachers who taught in this conventional fashion voice their concerns and frustrations that many of the ideas underlying the present work began to take root.

One of the primary reasons for the persistence of prevailing practice through many decades of American education is its very presence and prevalence. It is, after all, the form of instruction students are most likely to observe while in school, in training, and as neophyte teachers. Not much in the way of alternative training seems to be available, either through education courses or teachers' manuals that accompany published textbooks (Askov, 1982).

A second source of persistence may be the textbook itself. The textbook need not be treated as a "script" to permit students to "hear the text," as some have described it; indeed, the present data suggest that oral reading is not a necessary component of effective instruction. But in view of some of the real constraints imposed on content area instruction, oral reading of the text (the most readily available material) presents itself as the most feasible solution. And, as we have seen, if the principal objective is to ensure that students do indeed acquire content, it is far superior to simply expecting them to acquire it on their own.

A third, and perhaps the most serious single constraint operating during content area instruction, is the limited amount of instructional time available. Three 40-minute class periods per week for social studies and two for science instruction are generous by some standards. In this limited period of time, teachers are expected to cover an enormous amount of content as defined by the textbook contents for each grade level, which constitutes the "curriculum" for these subject areas. Because time is so limited, teachers have not the luxury of grouping for instruction, and so they must expose students representing a wide range of knowledge and reading levels to the same material simultaneously.

Viewed from this perspective, prevailing practice seems to be a very pragmatic adaptation to very real constraints. First, it is efficient in that it virtually guarantees that most, if not all, the text information will be exposed, making it accessible to those students who have great difficulty reading. Next, it allows those students who are more knowledgeable to contribute often enough, without penalizing or slighting their less knowledgeable peers, to clarify important points so that the teacher does not always assume the role of "telling" the students what is in the textbook. Finally, the format of such instruction is very familiar to students, minimizing time that must be spent organizing them for instruction and maintaining order.

A final reason concerns the ease of planning for this kind of instruction, as well as the relatively undemanding nature of the delivery of instruction. In the course of an extremely crowded elementary school day, the burden of planning for multiple groups in multiple curricular areas quickly approaches an unrealistic level. It seems understandable that teachers would naturally reserve a good deal of their planning effort for those curricular areas that command the greatest public attention, strictest accountability, and the most instructional time--reading and mathematics.

Impediments to Attempting to Change Practice

There are several reasons for the persistence of prevailing practice, some outside the teacher's control altogether. These and other factors constitute impediments to attempting to change practice. Apart from the reasons cited earlier, there may be other impediments to any change effort. Even if a teacher chose to modify his or her practice, there would be the ubiquitous problem of infrequent or nonexistent

professional attention and support to inform and guide the teacher in that effort. In the case of the present work, though, there are two primary impediments. One stems from the way that "reading" instruction is usually conceptualized. The other concerns the dominance of textbooks that cover a great deal of content, even at the fourth-grade level, in a less than considerate fashion.

As reading instruction is currently conceptualized, we devote approximately 3 years to helping students acquire beginning level reading skill, and we provide them with a good deal of exposure to narrative texts. As students get older and move into the intermediate grades, they still read many narratives during "reading" instruction, but they begin to develop literary appreciation skills, and cease working on the lower level skills that characterized earlier instruction. At the same time that students stop being instructed in "how to read," they begin content area instruction (fourth grade), which, as we have said repeatedly, is textbook dominated. Prior to that time, their preparation for this sort of reading has, to a large extent, consisted of limited exposure to expository texts and an equally limited cycle of instruction aimed at strengthening content area reading skills. If large amounts of time continue to be allocated to this particular kind of reading instruction, and teachers continue to have limited time to cover extensive quantities of material, teachers will have great difficulty attempting to adopt the Integrative instructional procedures.

If, on the other hand, either content area instruction were to be given higher priority, and/or the fundamental design of the reading curriculum were to be modified to include the present sort of instruction as *reading* instruction, practice might change to incorporate what certainly appear to be more effective practices than the present ones. Then, teachers might be able to deal with a connected body of content on a daily basis with smaller groups of students for entire class periods.

The current practice in reading instruction of teaching a limited set of study skills with a series of unrelated passages is unlikely to prove as effective. In contrast to much of the work aimed at improving study skills, and the approach by most published reading programs, the present work approached student performance *through* a specific body of content rather than *independently* of a specific body of content. The materials used with these fourth-grade students were of real consequence, not merely serving as practice materials.

Since much of the previous work that helped to shape the development of the integrative discussion did focus on the development of content-independent skills, we can return to some of our introductory discussion to attempt to characterize the present work in relation to it. In examining the present findings, we can say that, in general, the practice of having the teacher initially assume the burden for applying "study skills" proved an effective one. Teacher-guided discussion can function as an opportunity for quite systematic analysis, or study, of the text. In this sense, then, both the Discrete and the Integrative treatments can be characterized as attempts to *externalize* in a group forum what must ultimately become an internal studying process. We might say then that the Discrete treatment resembles a studying strategy of rereading or copious underlining, while the Integrative parallels the more effective techniques that extract and exploit both knowledge and text structure at various levels.

We can argue then that the Integrative form of instruction was effective as a form of "group studying," and led to facilitation of both knowledge acquisition *and* reading comprehension. The fact that these results were achieved with instruction that focused on specific content is especially noteworthy. First, the instruction influenced reading comprehension without sacrificing valuable instructional time available for helping students acquire knowledge about important content areas. Second, the results suggest that such an approach may well constitute a firm foundation for later instruction in content-independent, more widely generalizable strategies.

The findings of the current study do strongly suggest that we reconsider our instructional goals for reading and for the content areas; we must weigh carefully how much our students are learning about learning in our classrooms. We conclude with a conviction that while the present findings do carry implications for changing practice, the burden for realizing those changes must not be presumed to rest

solely with the teacher. Efforts at all levels--the classroom, the school, the district, the university classroom, and the publishing houses--will be needed to achieve the reform necessary to help students "read to learn."

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Table 1

Means and Standard Deviations* - Knowledge Acquired - Study 1 (N = 48)

Group	Pretest	Day 1	Day 2	Day 3	Day 4	Day 5	Posttest
1 Reading Only	8.83 (4.09)	6.08 (3.29)	6.73 (2.76)	3.33 (2.96)	4.42 (3.12)	4.67 (2.57)	11.00 (5.13)
2 Discrete	9.17 (3.56)	9.64 (6.65)	9.17 (3.38)	7.67 (3.70)	8.00 (5.00)	9.00 (2.93)	14.92 (5.35)
3 Integrative w/o Text Ref.	8.83 (3.30)	7.33 (5.80)	6.27 (3.44)	7.27 (3.50)	8.25 (4.85)	8.00 (2.83)	14.75 (4.47)
4 Integrative	8.17 (4.95)	10.45 (4.57)	9.82 (2.60)	9.36 (2.84)	8.67 (3.92)	8.91 (3.39)	15.75 (5.08)

*Standard Deviations in parentheses below means

Table 2

Means and Standard Deviations* - Transfer to Independent Reading - Study 1 - RELATED PASSAGE - TERMITE SOCIETIES (N = 48)

Group	Short Answer	Similarities and Differences
1 Reading Only	11.17 (4.51)	6.17 (4.37)
2 Discrete	14.00 (4.09)	7.58 (2.84)
3 Integrative w/o Text Ref.	(12.45 (5.37)	8.55 (3.11)
4 Integrative	14.50 (4.21)	7.92 (4.23)

*Standard Deviations in parentheses below means

Table 3

Means and Standard Deviations* - Text Reference - Study 1 (N = 48)

Group	Locating Information				Using Subheadings	
	Speed		Accuracy			
	Pre	Post	Pre	Post	Judgment	Identification of Subsections
1 Reading Only	6.04 (1.55)	5.28 (2.39)	8.17 (2.29)	7.75 (2.14)	9.33 (2.35)	4.67 (1.92)
2 Discrete	7.88 (1.51)	4.91 (1.46)	8.33 (2.53)	8.58 (3.34)	9.17 (3.88)	3.67 (2.77)
3 Integrative w/o Text Ref.	6.13 (.94)	5.53 (2.14)	7.67 (2.99)	8.50 (2.15)	11.30 (2.41)	4.80 (2.74)
4 Integrative	7.89 (2.31)	5.79 (2.70)	7.75 (2.73)	9.17 (2.37)	11.17 (2.52)	6.42 (2.11)

*Standard Deviations in parentheses below means

Table 4

R^2 Change Associated with Treatment Effects - Study 1 (N = 48)

	Prior Knowledge	C_1	C_2	C_3	Total R^2
Knowledge Acquired					
Day 1	.48[d]	.04[a]	.005	.03	.56
Day 2	.46[d]	.05[b]	.002	.10[c]	.61
Day 3	.47[d]	.23[d]	.02[a]	.003	.72
Day 4	.46[d]	.10[c]	.006	.005	.60
Day 5	.28[d]	.22[d]	.002	.017	.52
Posttest	.54[d]	.13[d]	.016	.004	.68
Transfer					
Short Answer	.36[d]	.06[b]	.009	.03	.46
Similarities/ Differences	.23[d]	.05	.006	.005	.29
Text					
Locating Info.					
Speed	.28[d]	.019	.021	.081[b]	.40
Accuracy	.48[d]	.04	.02	.000	.55
Using Subheadings					
Judgment	---	.03	.06[a]	.02	.11
Identification of Subsections	---	.002	.16[c]	.001	.16

Contrasts

C_1 Instruction/No Instruction (2, 3, 4/1)
C_2 Discrete/Integrative (2, 4)
C_3 Text Reference/No Text Reference (2, 4/3)

[a] $p \leq .10$
[b] $p \leq .05$
[c] $p \leq .01$
[d] $p \leq .001$

Table 5

Readability Levels of Instructional and Transfer Texts

	Length	Dale-Chall Score	Dale-Chall G.E.	Fry Sent	Fry Syllables	Fry G.E.
Introduction						
(1)	697	5.96	5-6	7.6	148	7
(2)	521	6.45	7-8	7.1	143	7
Ant Societies						
Day 1	508	5.64	5-6	7.6	131	6
Day 2	510	6.53	7-8	7.1	134	6
Day 3	605	5.88	5-6	8.1	125	4
Day 4	497	5.44	5-6	6.5	140	7
Bee Societies						
Day 1	500	5.44	5-6	8.8	125	4
Day 2	511	6.99	7-8	7.8	144	7
Day 3	571	6.10	7-8	6.7	136	7
Day 4	560	5.00	5-6	7.6	121	4
Termite Societies						
Day 1	602	6.90	7-8	8.8	136	5
Day 2	490	6.88	7-8	6.9	135	6
Day 3	534	7.32	9-10	7.8	141	7
Day 4	599	6.61	7-8	7.8	126	5
Paper Wasps	669	6.48	7-8	7.4	130	6
Micmac Indians	677	5.37	5-6	7.0	125	5
Landforms	414	6.32	7-8	7.9	145	7

Note: Scores reported are average of 2 samples/passage

Table 6

Knowledge Acquired: Summary of R^2 Change Associated with Treatment Contrasts - Study 2

Dependent Measure	Contrast 1 R^2 Change	Contrast 2 R^2 Change	Total R^2
Booklet			
Factual	.17*	.15*	.51
Explanation	.22*	.11*	.53
Application	.10*	.10*S	.44
Total	.23*	.17*	.63
Multiple Choice Posttest	.20*S	.06	.50

* F value significant

S School by Contrast interaction

Contrast 1: No Instruction (Independent Reading)/Instruction (Discrete and Integrative)

Contrast 2: Discrete Instruction/Integrative Instruction

Table 7

Means* and Standard Deviations - Knowledge Acquired - Study 2**

Dependent Measure	1 Independent Reading No Instruction		2 Discrete		3 Integrative		2 & 3 Instruction	
Multiple Choice Posttest	23.71 (9.24)	[23.17]	32.17 (10.92)	[31.25]	38.38 (9.38)	[38.32]	35.27 (10.54)	[34.87]
Booklet (1-12) Factual	.33 (.12)	[.33]	.41 (.10)	[.40]	.56 (.18)	[.56]	.48 (.16)	[.48]
Explanation	.21 (.11)	[.21]	.32 (.13)	[.31]	.45 (.17)	[.45]	.39 (.16)	[.39]
Application	.21 (.11)	[.21]	.26 (.12)	[.25]	.37 (.16)	[.35]	.31 (.15)	[.31]
Total	.27 (.11)	[.27]	.38 (.12)	[.37]	.54 (.16)	[.54]	.46 (.16)	[.46]

*Observed *M* followed by Adjusted *M* in brackets

**Standard Deviations in parentheses below Observed *M*'s

Table 8

Means* and Standard Deviations - Transfer to Independent Reading - Study 2**

Dependent Measure	1 Independent Reading	2 Discrete	3 Integrative	2 & 3 Instruction
Closely Related Passage				
Paper Wasps	10.39 [10.77]	11.35 [11.01]	17.43 [17.39]	14.39 [14.27]
Short Answers	(5.19)	(6.34)	(5.25)	(6.67)
Similarities and	2.92 [2.24]	2.50 [2.54]	5.21 [5.17]	3.85 [3.81]
Differences	(1.97)	(1.50)	(2.48)	(2.48)
Related Passage				
Micmac Indians	13.62 [13.78]	14.57 [14.23]	20.48 [20.36]	17.52 [17.33]
Short Answers	(4.67)	(4.99)	(5.96)	(6.22)
Similarities and	2.29 [2.24]	2.67 [2.70]	4.50 [4.53]	3.58 [3.55]
Differences	(1.23)	(1.78)	(2.56)	(2.40)
Unrelated Passage				
Landforms	13.38 [13.57]	13.17 [12.84]	16.57 [16.47]	14.87 [14.72]
Short Answers	(5.57)	(5.66)	(6.76)	(6.48)
Written Recalls	12.08 [11.87]	8.83 [8.27]	14.42 [14.17]	11.63 [11.35]
	(10.60)	(7.80)	(11.38)	(10.11)

*Observed *M* followed by Adjusted *M* in brackets

**Standard Deviations in parentheses below Observed *M*'s

Table 9

Transfer to Independent Reading: Summary of R^2 Change Associated with Treatment Contrasts - Study 2

Dependent Measure	Contrast 1 R^2 Change	Contrast 2 R^2 Change	Total R^2
Paper Wasp Societies			
Short Answer	.06*	.19*	.41
Essay	.01	.26*	.37
Micmac Indian Society			
Short Answer	.08*S	.18*	.63
Essay	.06*	.16*	.26
Landforms			
Short Answer	.01	.08*	.33
Free Recall	.01	.07*	.33

* F value significant

S School X Contrast interaction

Contrast 1: No Instruction (Independent Reading)/Instruction (Discrete and Integrative)

Contrast 2: Discrete Instruction/Integrative Instruction

Table 10

Means* and Standard Deviations - Knowledge Frameworks - Study 2**

Dependent Measure	1 Independent Reading		2 Discrete		3 Integrative		2 & 3 Instruction	
Insect Society Schema								
Topics	1.32 (1.17)	[1.30]	.64 (.95)	[.65]	2.57 (1.04)	[2.56]	1.62 (1.39)	[1.62]
Items	2.23 (2.58)	[2.23]	1.77 (2.16)	[1.76]	7.35 (3.30)	[7.34]	4.62 (3.95)	[4.58]
Predictions								
Text Content	1.05 (.95)	[1.00]	1.32 (1.04)	[1.32]	2.52 (1.83)	[2.51]	1.93 (1.60)	[1.77]
Text Organization	2.73 (2.00)	[2.71]	3.64 (1.89)	[3.63]	3.78 (2.11)	[3.78]	3.71 (1.98)	[3.63]
Chart Completion	4.60 (2.19)	[4.61]	3.52 (2.00)	[3.52]	5.65 (1.64)	[5.65]	4.59 (2.10)	[4.59]

*Observed *M* followed by Adjusted *M* in brackets

**Standard Deviations in parentheses below Observed *M*'s

Table 11

Knowledge Frameworks: Summary of R^2 Change Associated with Treatment Contrasts - Study 2

Dependent Measure	Contrast 1 R^2 Change	Contrast 2 R^2 Change	Total R^2
Insect Society Schema			
Topics	.01	.37*	.40
Items	.06*	.40*	.50
Predictions			
Content	.07	.04	.09
Organization	.06*	.2*	.30
Chart Completion	.00S	.19*	.31

* F value significant

S School X Contrast interaction

Contrast 1: No Instruction/Instruction

Contrast 2: Discrete InstructionIntegrative Instruction

Table 12

Means* and Standard Deviations - Knowledge Acquired - Study 3**

Dependent Measure	Visual Representation		Text Reference	
Multiple Choice Posttest	37.67 (9.91)	[38.31]	35.25 (8.76)	[34.84]
Booklet (1-12)				
Factual	.51 (.16)	[.52]	.47 (.15)	[.46]
Explanation	.42 (.18)	[.43]	.32 (.11)	[.31]
Application	.33 (.16)	[.34]	.27 (.14)	[.26]
Total	.49 (.17)	[.50]	.42 (.13)	[.41]

*Observed *M* followed by Adjusted *M* in brackets

**Standard Deviations in parentheses

Table 13

Predicted Performance in Other Treatment Groups in Percentiles

Dependent Measure	Discrete in Reading Only	Integrative in Reading Only	Integrative in Discrete
Knowledge Acquisition			
Unit 1	75	96	87
Unit 2	70	99	94
Week 2	75	99	92
Unit 3	84	99	84
Booklet			
Factual	72	97	95
Explanation	82	99	86
Application	64	90	80
Total	82	99	92
Transfer to Independent Reading			
Paper Wasps			
Short Answer	52	90	84
Essay	56	93	96
Micmac Indians			
Short Answer	54	92	89
Essay	64	97	85
Landforms			
Short Answer	45	70	74
Free Recall	37	59	78

Table 13 (Continued)

Predicted Performance in Other Treatment Groups in Percentiles

Dependent Measure	Discrete in Reading Only	Integrative in Reading Only	Integrative in Discrete
Knowledge Frameworks			
Insect Society Schema			
Topics	29	86	98
Items	43	98	99
Predictions			
Content	63	94	87
Organization	68	71	53
Chart Completion	31	68	86

Note. Percentiles computed by first finding a z-score ($M_E - M_C/s.d._C$) and then finding the appropriate point in the unit normal distribution.

Figure Captions

Figure 1. Study 2 treatment group means and contrasts on multiple choice posttest.

Figure 2. Study 2 treatment group means and contrasts on Total Booklet scores.

Figure 3. Study 2 treatment group means and contrasts on Closely Related transfer passage (Paper Wasps).

Figure 4. Study 2 treatment group means and contrasts on Related transfer passage (Micmac Indians).

Figure 5. Study 2 treatment group means and contrasts on Unrelated transfer passage (Landforms).

Figure 6. Means from the five treatment groups of Study 2 and Study 3.

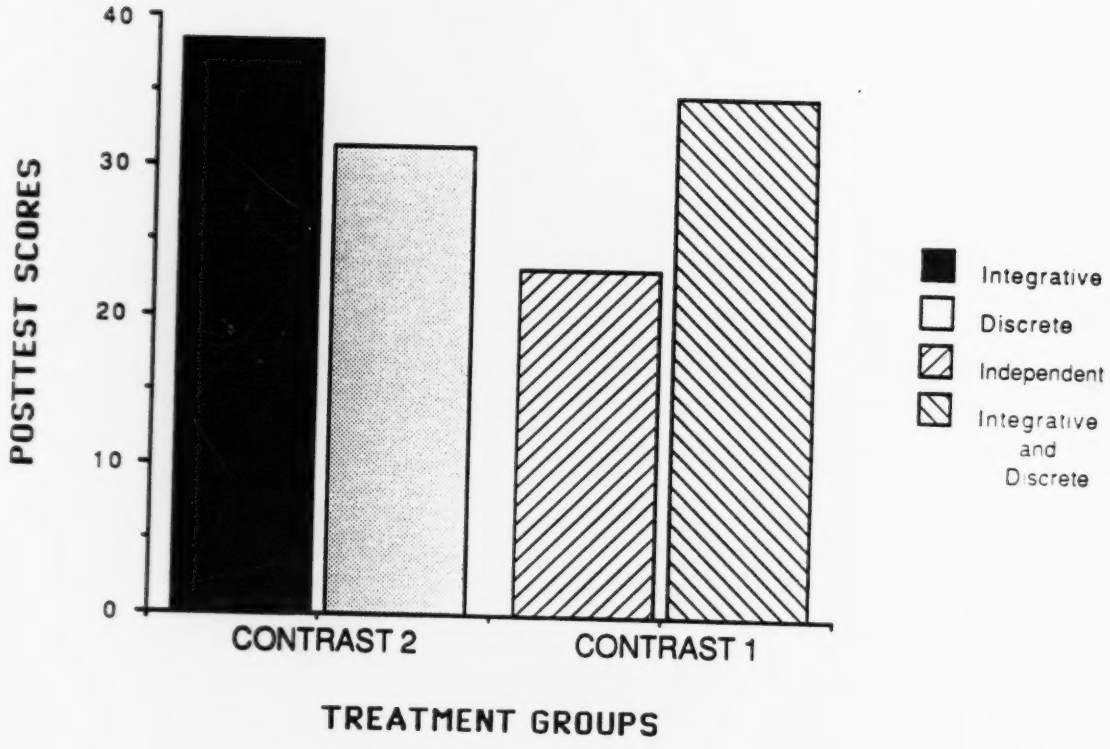

40
30
20
10
0
POSTTEST SCORES
CONTRAST 2
CONTRAST 1
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative and Discrete

Figure 1

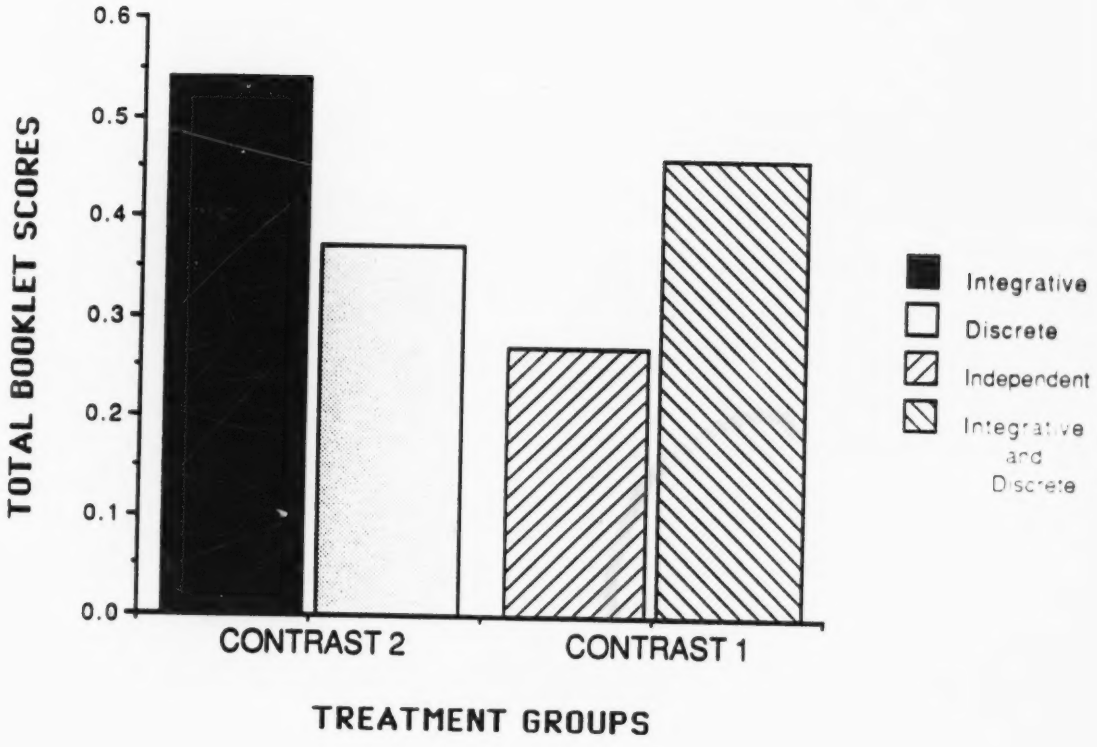

TOTAL BOOKLET SCORES
0.6
0.5
0.4
0.3
0.2
0.1
0.0
CONTRAST 2
CONTRAST 1
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative and Discrete

Figure 2

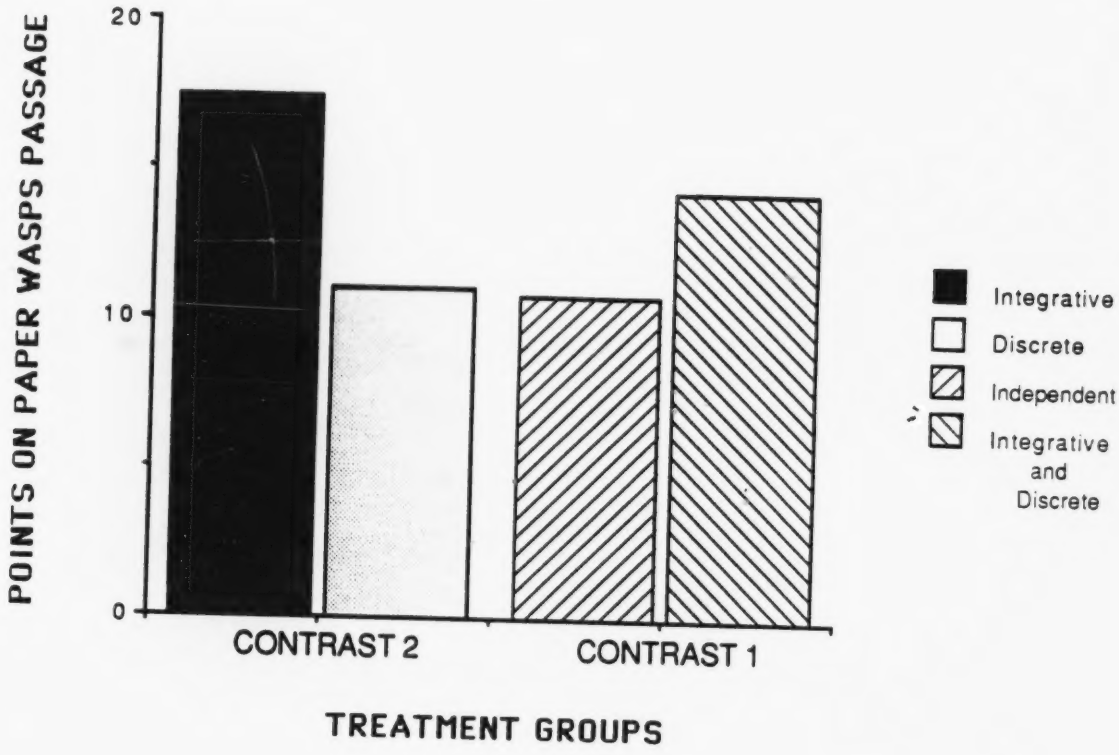
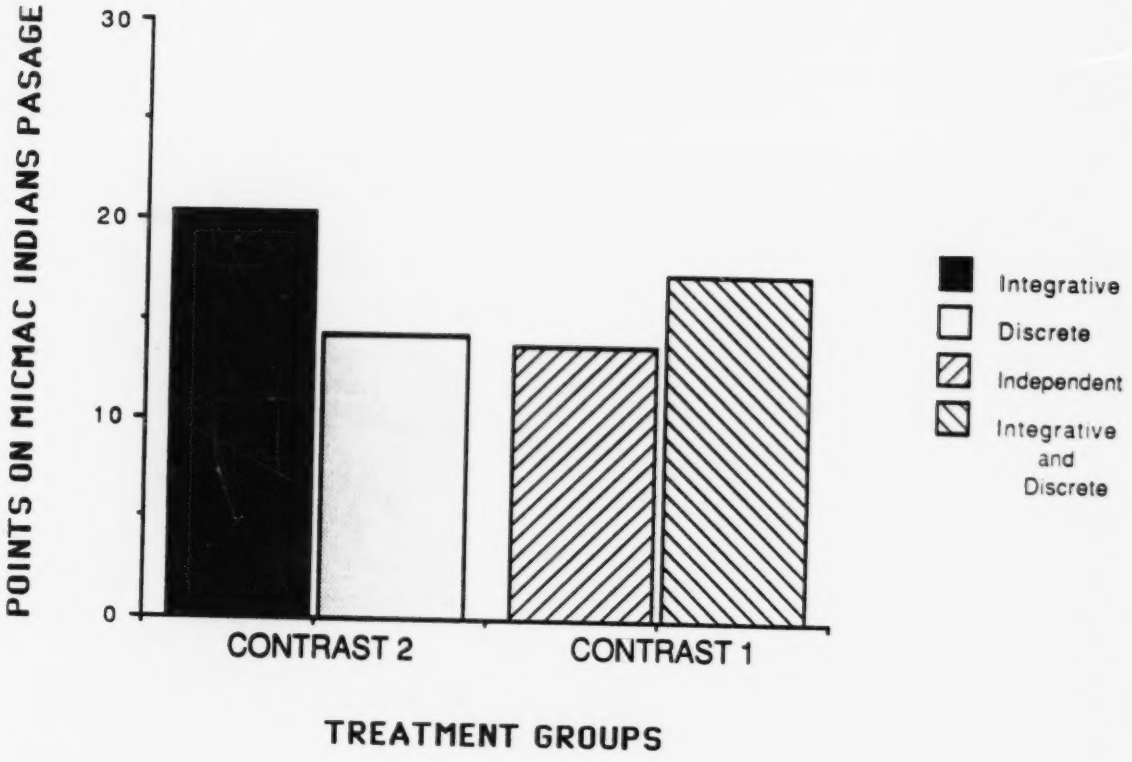

POINTS ON PAPER WASPS PASSAGE
20
10
0
CONTRAST 2
CONTRAST 1
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative and Discrete

Figure 3


POINTS ON MICMAC INDIANS PASAGE
30
20
10
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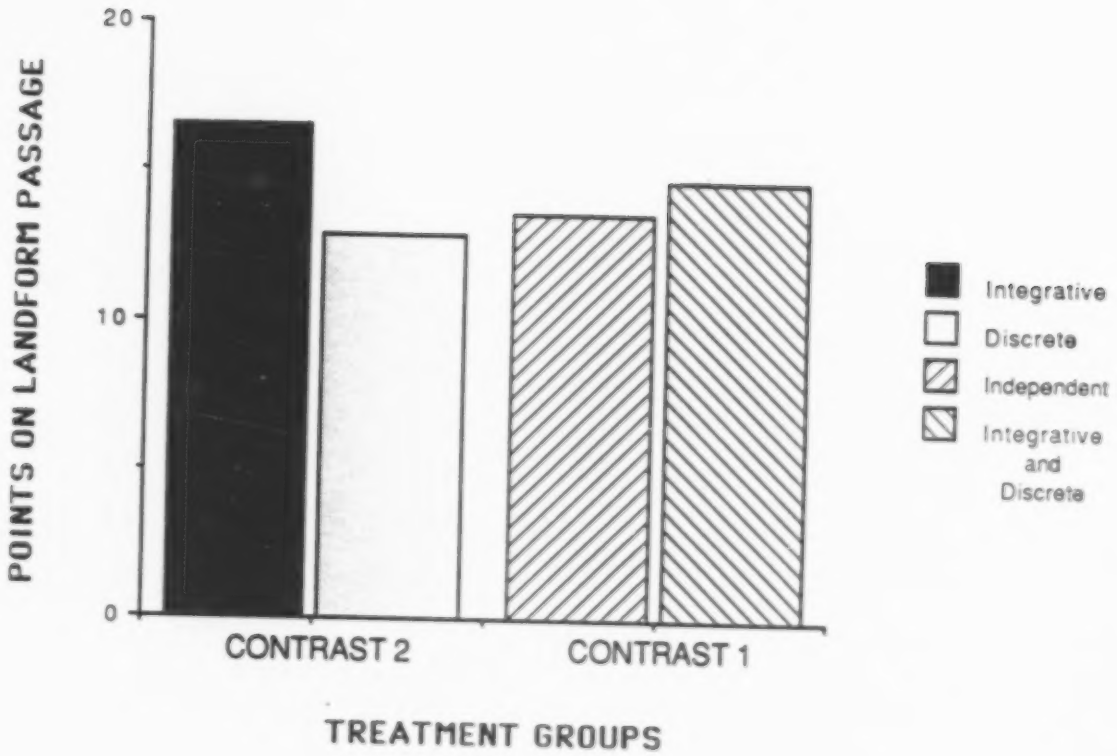
CONTRAST 2
CONTRAST 1
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative and Discrete

Figure 4


20
10
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POINTS ON LANDFORM PASSAGE
CONTRAST 2
CONTRAST 1
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative and Discrete

Figure 5

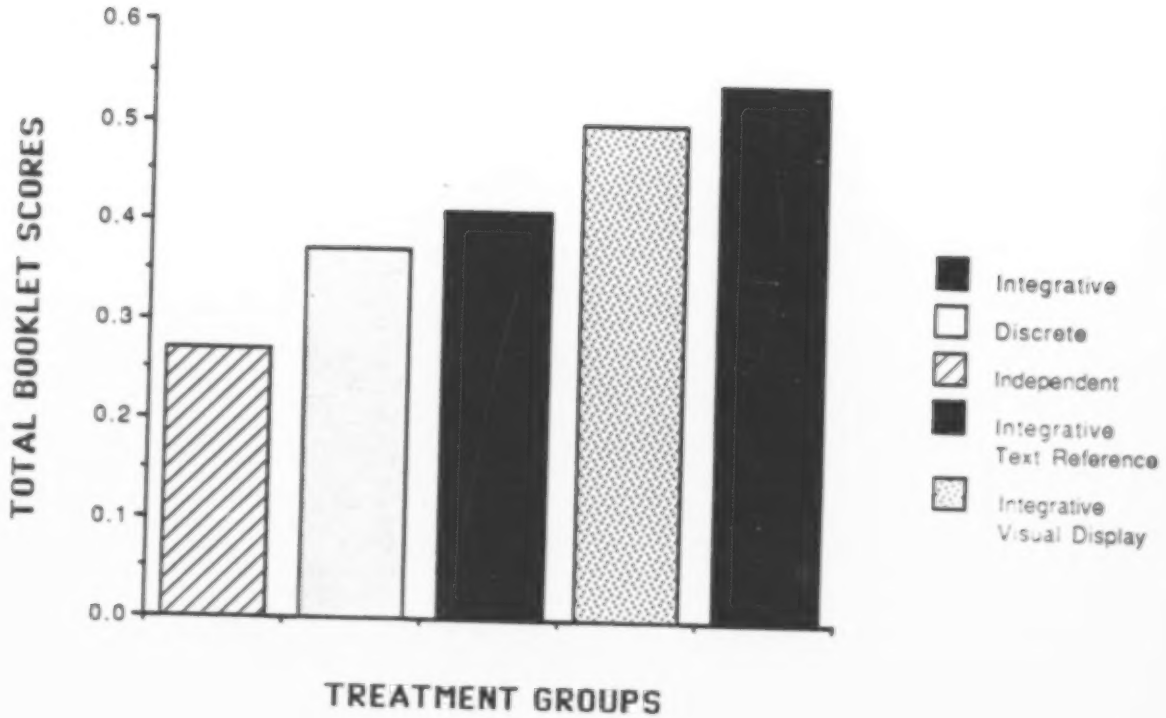
TOTAL BOOKLET SCORES
0.6
0.5
0.4
0.3
0.2
0.1
0.0
TREATMENT GROUPS
Integrative
Discrete
Independent
Integrative Text Reference
Integrative Visual Display

Figure 6